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POTENTIAL IMPACTS OF SELECTED ENERGY AND MINERAL SCENARIOS WITHIN THE CALIFORNIA DESERT CONSERVATION AREA

FINAL REPORT

PREPARED FOR

UNITED STATES DEPARTMENT OF INTERIOR

BUREAU OF LAND MANAGEMENT

DENVER, COLORADO

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1 INTRODUCTION

This report was prepared as per the prime contract with the U.S. Department of Interior, Bureau of Land Management, referenced as Contract Number YA-512-CT9-289. The purpose of the study was to identify six potential energy and mineral resources within the California Desert Conservation Area (CDCA) and to summarize the impacts associated with exploiting them in the most economical fashion. These resources were separated into sets of two, located in each of three different theoretical environments, typical of those found within the CDCA. The study focused on typical activities and impacts associated with the exploration, development, production and reclamation of the six resources. The final analysis was reflected in a detailed impact matrix.

Work for the analysis was performed by a select team of experts from Omniplan Corporation, including Dr. William Peters, Mr. William Beatty and Mr. Laurence P. James---geology; Dr. Sayed El Wardani---hydrology; Mr. Ronald Pifer---biology; and Dr. Raymond Brandes---cultural resources.

Major topics of the report include regional environment, energy and mineral activities and impact scenarios. An appendix contains supplementary information on known mining districts and groups.

2

REGIONAL ENVIRONMENT

2.1 PHYSIOGRAPHY

The California desert conservation area (CDCA) includes approximately 25 million acres of arid and harsh desert lands, interspersed with rocky hills and sparsely vegetated mountains, as noted in Exhibit 2-1.

A small portion of the Great Basin desert, extending into California from Nevada, is included within the extreme northern area of the CDCA, just east of Bishop. Moving south, the CDCA is bounded by the California-Nevada state boundary to the east and to the west by the White and Inyo mountains, with elevations up to 11,000 ft. Numerous other north-to-south mountain ranges comprise the Great Basin ranges of the CDCA. In addition, Death Valley, the lowest point in the United States at 282 feet below sea level, and the smaller Panamint Valley are two major valleys in the Great Basin area. Just west of the Panamint Valley is situated the naval weapons center at China Lake.

The Mojave desert lies south of the Great Basin area, extending up to 200 miles from the eastern slopes of the Tehachapi mountains and northern extremities of the San Gabriel and San Bernadino mountains, east to the California-Nevada state boundary at the northeast edge, and the Colorado River at the southeast edge in the vicinity of Needles, California. Other major cities include Baker, Barstow, and Lancaster. Several military installations are situated in the Mojave Desert, including the naval weapons center Mojave B Range, the Camp Irwin Military Reservation, Edwards and George Air Force Bases, and the Marine Corps Training Center. The Mojave Desert is characterized by numerous valleys and basins with several widely-scattered mountain ranges running from the northwest to southeast. Elevations range from a few hundred to about 5,000 feet, though the broad valley and basin floors have approximately 2,500 foot elevations.

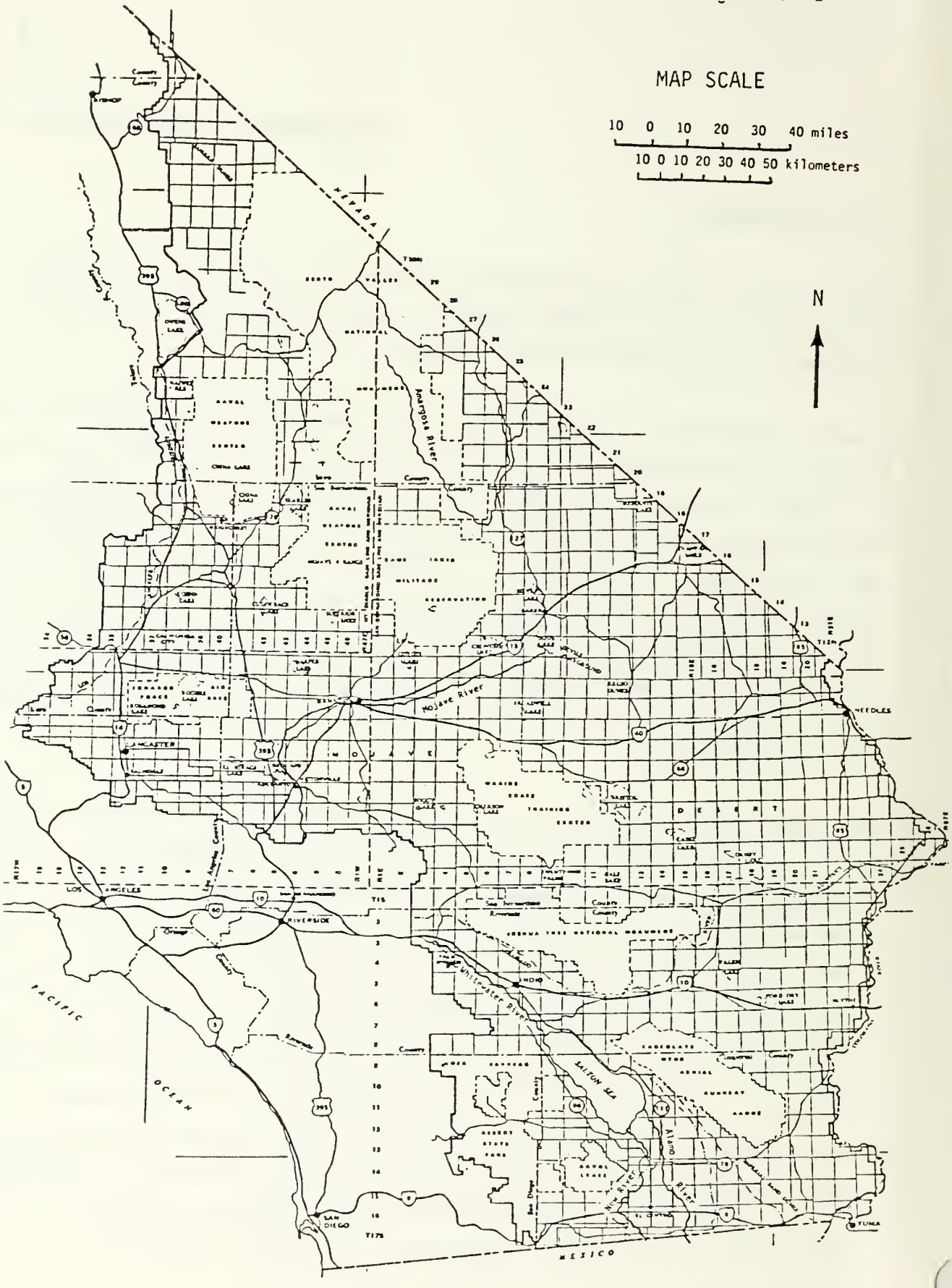


EXHIBIT 2-1: STUDY REGION

2.1 PHYSIOGRAPHY (continued)

The Colorado Desert lies south of the Mojave Desert and is considerably narrower, averaging approximately 90 miles in width, extending from the western borders of Coachella Valley and Anza-Borrego Desert State Park on the west to the Colorado River on the east. Major cities include Palm Springs and Indio in the Coachella Valley, and El Centro in the Imperial Valley and Blythe, on the Colorado River. Major natural features include the Salton Sea, more than 200 feet below sea level, Joshua Tree National Monument, and the Chocolate Mountains. A major military installation is located here, called the Chocolate Mountains Aerial Gunnery Range.

2.2 GEOLOGY

The geological environment of the CDCA is comprised of four very general, visually-distinct rock types. Each of these can occur in any of the three hypothetical environments described later in this report. They may be found at the surface or beneath it, and in some parts of the CDCA they may occur on top of one another, or placed against each other by faulting. In some cases only one rock type is exposed, masking the presence of others hidden beneath the surface.

The most complex, and generally the oldest, of the rock types are the deformed, metamorphosed basement rocks. These rocks are hundreds of millions to billions of years in age. They originated as sedimentary and igneous rocks near the surface, and their development included multiple episodes of burial, folding and heating. Some of these episodes were accompanied by intrusions of igneous material.

Some of the basement rocks are of Precambrian age (older than about 600 million years). These include gneiss and schist, as found in the Ivanpah quadrangle near the eastern boundary of the CDCA.[1] The most abundant Precambrian rocks are deformed granites, or granite gneisses. Some of these show evidence of relatively high temperature metamorphism, and lit-par-lit (layer between layer) injection of quartz-feldspar-rich

rock. Others show extensive mashing or mylonization, resulting from the major earth movements that have characterized the region throughout most of its history. Early geologists tended to lump all metamorphosed, deformed rocks as Precambrian in age, yet it is now known that much later deformations have metamorphosed rocks of younger ages. Still, controversy exists over the ages of some of the rocks and events.[2]

A second, less deformed group of rock types consists of the sedimentary rocks such as limestones, shales, cherts, and younger cross-cutting igneous intrusions. Although they are considered separate, a clear-cut division between this group and the metamorphosed basement rocks is not always possible within the CDCA.

The limestones and shales of this category, such as those found in the Darwin area and the adjacent Inyo Mountains, sometimes contain fossils.[3] The granitic intrusive rocks formed as hot magmas, and have had profound effects on local limestones, creating calcium-magnesium silicate minerals and bleached marble. The region where this has occurred is known as the contact-metamorphic or skarn environment, and it contains a variety of known and potential ore deposits.

The limestone and shale environment was largely of Paleozoic age, (600 million to 225 million years) and was very similar to that found in the Great Basin, which stretches far into Central Utah and Northern Nevada. By early Mesozoic time (225-to-180 million years), great changes were occurring in all of these areas, and the youngest marine rocks were being interspersed with volcanic rocks. The emplacement of igneous intrusions also started at about this time. These intrusions were typically of highly variable, granitic-to-dioritic composition and are quite abundant.

A third rock group consists of widespread volcanic flows and air-and water-laid, ash-and-cinder deposits. Small intrusive bodies of similar age commonly underlie these deposits. Rock ages in this group span much of Tertiary time (1-to-70 million years), with the youngest having an appearance of erupting in Recent geological times (less than 1 million years old).

Non-marine sandstones (river and lake sediments) locally rich in vertebrate fossils are also abundant within this group. They cover large areas toward the center of the CDCA and have long been studied by T.W. Dibblee and others.[4,5] They, too, have undergone folding and faulting and are more easily eroded than the more metamorphosed and compacted earlier rocks. Hence the non-marine sandstones tend to form low desert landforms. Some of them are also undergoing present-day chemical changes and may still be forming some kinds of mineral deposits.[6,7]

A fourth and youngest group, whose characterization as rock is tenuous, consists of gravels, salt-rich playas, and other poorly-consolidated sediments. These sediments locally interfinger with volcanic rocks. In addition, the thick unconsolidated material of this group often covers and obscures the other three groups of rock materials and conceals many of the potential mineral deposits.

Ongoing chemical changes in these rocks in the arid desert environment are important in forming salt and clay deposits in the region. Many playas and even some of the groundwater beneath the valleys filled with recently-deposited sediments are 'fossil' remnants of wetter climates that affected the area in Pleistocene times (1 million years ago or less).[8,9]

The four groups of rock types preserve a record of numerous structural events, resulting from the breaking, bending, and burial of the earth's crust. These events are manifested by two great faults in the CDCA: the San Andreas in the southwest and the Garlock in the north-northeast. Both have been active through long periods of geologic time, probably from the

Mesozoic to Recent times. Both have lateral displacements, or strike-slip, which are measureable in miles and affect present landforms extensively. They enclose the Mojave Desert which comprises a great wedge-shaped block lying between them.

In the eastern part of the CDCA, many faults occur at the borders of mountain ranges. They probably represent the extension of the earth's crust, caused by powerful forces at great depths. This faulting and the probably related adjustments along major strike-slip faults farther west, is closely associated with present-day earth tremors. However, many of the older fault planes, commonly associated with igneous intrusions, have no relation to present-day earthquakes. They reflect earlier eras when the region underwent multiple kinds of geologic activity.

2.3 SOILS

Soils in the CDCA typically show little development, owing to the arid, wind-swept, poorly-vegetated character of the region; the common occurrence of flash floods; and the precipitation of salts within closed basins.

In the mountainous regions typical soils are shallow, stony loams and sands. In lower terrains the soils are more varied, and include loamy sands, clay loam, and hard caliche.[1] Soils in closed drainage basins include fine textured soils with accumulations of saline material.

The casual observer might conclude that much of the area simply lacks soil. However, soil scientists describe a number of soil types and associations for specific regions of the CDCA. Some of the more important ones are described in Chapter 4, under Three Hypothetical CDCA Environments.

---

[1] Hard calcium carbonate deposits

2.4 HYDROLOGY

The surface and groundwaters of the CDCA are scarce. In general, the area is arid and evaporation losses are high. Reasonably good surface flows occur in the Uplands, the Sierra Nevada, White, San Gabriel and San Bernardino Mountains. However, only the largest of these flows persists to the valley floor and even they end up seeping into the dry desert alluvium. Hydropower developments and irrigation demands have eliminated many streams and subjected others to wide fluctuations in flow. Also groundwater pumping and limited replenishment has caused serious overdraft and the lowering of groundwater levels in many areas.

2.4.1 Surface Water

The surface water resources of the CDCA fall into four major classes: 1) springs, 2) aqueduct systems, 3) small drainage ways, and 4) major drainage ways. Numerous small drainage basins are found in the mountains of the uplands; however, the major drainage systems are of primary interest to this study. This is because their low quantity and quality limit the utility of their runoff. Their flows are often ephemeral, or irregular; they are dry much of the year and only after a storm do they have high flows.

The water quality of the desert streams, particularly the small ones, is relatively poor, with high concentrations of dissolved solids, boron, magnesium, and sodium, as well as high particulate loads characteristic of flood periods.

The major drainage systems within CDCA are 1) Mojave, 2) Whitewater, 3) Amargosa, 4) Alamo, and 5) New Rivers, as shown in Exhibit 2-1. A description of each of these systems follows, including peak flows.

2.4.1.1 The New and Alamo Rivers

These two rivers serve as drainage systems for excess agricultural waters, as well as municipal and industrial wastes from Mexicali, Mexico. The water quality of these rivers is poor, with typically high total dissolved solids(TDS) and coliform concentrations. The California Regional Water Quality Control Board has identified the pollution of these rivers as one of the primary planning objectives under their 208 Water Quality Management Plan. Since much of the pollution originates in Mexico, agreements between USA and Mexico will be required and will be lengthy and costly. Sampling stations No. 10254970 at Calexico, No. 1025555 near Westmorland, and No. 10254730 near Niland maintain records of flow and quality of these rivers. The maximum flow on record was 2,500 cubic feet per second(cfs), occurring in 1976.

2.4.1.2 The Mojave River

The Mojave River originates in the San Bernardino Mountains south of Victorville. It flows north through Victorville, gradually turning east to Barstow, then flows northeastward from Barstow and terminates in the Soda Dry Lake beds south of Baker. The Mojave River bed is dry along most of its route, although there is a significant amount of subsurface flow. A substantial amount of surface flow also occurs after storms, especially during the spring. However, the river is controlled by the Mojave River Forks and Silverwood Reservoir Dams, so flooding problems are minimal.

The Mojave River has six primary data sites. However, some of the values recorded at these stations may be biased by upstream control structures. The primary stations are: No. 1026000 West Fork near Hesperia; No. 1026110 near Hesperia; No. 10261500 at Lower Narrows near Victorville; No. 10262000 near Hodge; and Station No. 10261500 at Barstow. The maximum flow on record from these localities was 70,600 cfs, which occurred in 1938.

The subsurface flow of the Mojave River is used extensively and is pumped for municipal water supplies, as well as for limited agricultural supplies.

2.4.1.2 The Mojave River (continued)

Hesperia, Victorville, and Barstow are the primary municipal users, although private wells and other communities also use the water. Supplies appear to be adequate near the mouth of the river, but serious overdrafts are occurring near Barstow and further downstream.

The Mojave River has been subjected to some severe pollution problems in the past, most notorious was the "Barstow Slug," which occurred from industrial and municipal wastes, reaching and polluting the Mojave River groundwater at Barstow. The polluted materials now lie as two plumes or tongues of degraded groundwater. Currently, these plumes are moving slowly downstream, rendering downstream wells unusable.

2.4.1.3 The Whitewater River

The Whitewater River originates in the San Bernardino Mountains above White Water, California, then flows southeast to the Palm Springs area. The river curves slowly eastward to Indio, then turns back to the southeast until it drains into the Salton Sea. The river is generally dry except after storms or during the snowmelt season. However, a year-round flow usually does occur downstream from Mecca, resulting from seepage and excess irrigation runoff.

Flooding has been a problem along the Whitewater, although construction of dikes and other control features has significantly reduced this problem. In addition, spreading dikes have been constructed in the main river channel to facilitate groundwater recharge with imported water.

There are three principal data sites along the Whitewater River, Station No. 10256000 at White Water, Station No. 10259300 at Indio, and Station No. 10259540 near Mecca. The maximum flow on record from these sites was 24,000 cfs, which occurred in 1965.

2.4.1.3 The Whitewater River (continued)

The Whitewater River basin is managed, primarily, by the Desert Water Agency and the Coachella Valley County Water District. At this time, the river channel is used for injection of imported Colorado River water as a flood control channel and as an agricultural drain to the Salton Sea.

2.4.1.4 The Amargosa River

The Amargosa River originates in Nevada, north of Beatty, then runs south through Shoshone, and Tecopa, California. The river then turns back to the west and the north, terminating in Death Valley National Monument near the lowest point in the United States, 282 feet below sea level.

The Amargosa River is characterised by high water temperatures, irregular flow, and poor water quality characteristics. The Amargosa has one major data collection site within the CDCA, at Tecopa. The maximum flow on record at this station was 5,000 cfs, occurring in 1969.

2.4.2 Groundwater

Large areas of the CDCA overlie groundwater storage, found in basins that are geologically and hydrologically favorable for the collection and storage of water. About 100 areas of known and potential groundwater storage have been identified thus far, found under more than 25,000 square miles. However, where groundwater is found, its use is often limited by poor water quality, low recharge rates, and various aquifer characteristics.

Groundwater development in the CDCA has primarly been for agricultural and domestic use. The amount of groundwater use varies from one basin to another. Some basins have virtually no development, while others have experienced problems of overdraft. Such overdrafts have occurred in

2.4.2 Groundwater (continued)

Antelope Valley, Lucerne Valley, Coachella Valley, and the Upper, Middle, and Lower Mojave Valleys.

Use of groundwater in many CDCA areas is especially limited by poor water quality, due to high quantities of total dissolved solids. Concentrations of these solids range from under 500 miligrams per liter to more than 100,000 miligrams per liter. In addition, concentrations of specific chemical constituents such as fluoride, sulfate, boron, and sodium may render the water unfit for drinking or irrigation.

2.5 BIOLOGY

2.5.1 Vegetation

The vegetation of the CDCA may be described in several ways, such as the structure of desert plants and the assemblage of groups of plants, called plant communities. Principal structural categories include the woody plants, such as small trees and shrubs; succulents, such as cacti; and perennial and annual herbs, such as grasses and daisies. Major community designations vary among authors and seem to be highly subjective in nature.[14]

Most of the trees of the CDCA deserts occur in the Colorado rather than the Mojave Desert. They are found along drainage channels, such as the Arroyo Seco and Wiley Wash areas, and in the vicinity of the Chuckwalla and Chocolate Mountains. Their leaves are typically small or non-existent, and their bark and stems are green with the presence of chlorophyll. Additional trees are found in the evergreen forests in the uplands above the deserts. They are represented by brown-barked trees with needles, such as pines and firs.

2.5.1 Vegetation (continued)

The shrubs are a major structural part of both deserts and the uplands surrounding the deserts. In the Mojave and Colorado Deserts, the stems of most shrubs contain chlorophyll, especially within the younger bark tissues. In the Great Basin portion of the northern CDCA, the plants have brown bark. In all areas, the shrubs typically have small leaves.

Succulents are also a common desert plant. Those that are particularly salt-tolerant are found in the closed drainage basins of the Colorado and Mojave Deserts, where the soil is continually moist. Those that are non-salt-tolerant occur in many other desert environments and possess succulent leaves or succulent stems. Those with the succulent stems are more prevalent in the Colorado Desert, while those with the succulent leaves are more common in the Mojave.

Perennial and annual herbs, especially the grasses, represent an important component of the vegetation of the CDCA. Most studies indicate that annual herbs make up about 40 percent of the desert flora, and may be as high as 88 percent for a Lucerne Valley bajada in the Mojave. Annuals may be considered as either summer or winter types; those categorized for winter growth are generally represented by a greater number of species due to more consistent fall and winter rains. During years with unusually high moisture, the production of biomass from annuals can exceed that from all the perennial plants.

Major woodland communities of the CDCA include pinyon-juniper, desert riparian(paloverde), desert oasis(palm), and Joshua tree. Major scrub communities include sagebrush, blackbush, creosote bush, mesquite, cheesebush, hopsage, shadscale, allscale, and desert holly. Major herb communities include saltgrass meadow and Joshua tree grassland.

In the Mojave Desert, the creosote bush reaches its northern limit and the Joshua tree, found only in the desert is common. Various types of saltbush communities are located around playas in the lower elevations. Other

2.5.1 Vegetation (continued)

communities include isolated islands of Great Basin communities, such as sagebrush and blackbush. The vegetation of the Colorado Desert is more sparse than that found in the Mojave. Typical communities are creosote, burrobush and brittlebush, intermixed with tree-dominated washes. Mountain areas are dominated by forests of pinyon pine, yellow pine, limber pine, bristle cone pine, and white fir. The wetland environments include communities of mesquite thickets, cottonwood and willow groves and palm oases.

2.5.2 Wildlife

The CDCA has over 635 species of vertebrates, including 419 species of birds, 94 species of mammals, 64 reptiles, 16 amphibians, and 42 fish, plus thousands of species of invertebrates. About half of the mammals are rodents with most of them living in burrows to avoid high daily temperatures and hibernating or estivating to avoid seasonal extremes. The carnivores of the CDCA are found in many places throughout the western U.S. except for the kit fox, which is regionally restricted. The only desert ungulates are the mule deer and the bighorn sheep, although the pronghorn antelope was once found throughout the CDCA.

Most of the bird species found in the study area are migratory and only 98 are considered year-long residents. Game birds include ducks and geese, plus the introduced chukar and ring-necked pheasant. Other introduced species include the house sparrow, starling, rock dove and spotted dove.

The reptiles of the desert are well adapted to the environmental conditions. Approximately 64 species are found in the CDCA, of which three are turtles and tortoises, 34 are lizards, and 27 are snakes. Most of them spend considerable amounts of time under the ground during the day, leaving the nights to forage for food. The diet of the snakes includes many of the rodents that are also out at night.

2.5.2 Wildlife (continued)

Amphibians are rare in the desert since they do need water for reproduction. Several of them, such as the salamanders, are endemic to a few selected springs. Another one, the Couch's spadefoot, survives the desert conditions by spending most of the year underground and emerging for breeding only during rainy periods. The total number of species is 16, with four salamanders, eight toads, two treefrogs and two frogs.

Only six of the 42 fish in the CDCA are native to the area. Four of these are found in the Amargosa River basin, one in the Mojave River basin, and one in the Salton Sea. They all have adapted to desert water conditions by being able to withstand high water temperatures, extreme daily and seasonal water temperatures, and high salinity. Additionally, they possess high reproductive capacities so they can respond quickly to major population setbacks.

The invertebrates in the CDCA are quite numerous and valuable to an effectively functioning desert ecosystem. Typical groups include insects, scorpions, whip-scorpions, millipedes, centipedes, and snails. They provide food for the larger vertebrates, aid in the recycling of nutrients, and pollinate flowers.

Over 100 different habitats have been characterized within the CDCA. General categories include the Great Basin Desert, Mojave Desert, Colorado Desert, mountains, wetlands, playas and sand dunes. Subdivisions within the Great Basin include shadscale scrub found in Fish Lake, Deep Springs and Eureka Valleys; and sagebrush found on the higher elevations. Wildlife living only in these communities include the pallid kangaroo mouse, Great Basin pocket mouse, and sagebrush mole.

In the Mojave Desert, the creosote bush reaches its northern limit and the Joshua tree, found only in this desert, is common. Various types of saltbush communities are located around playas and in the lower elevations. Particularly important wildlife in the Mojave includes the desert tortoise

and the Mojave ground squirrel. Wildlife within the Joshua tree communities is also important because of the understory variability, from shrubs to cactus to grasses, plus the addition of vertical form and height to the community. This latter condition provides excellent perches and nest sites for a number of animals, such as Swainson's and Red-Tailed Hawks, "Gilded" Common Flicker, Scott's Oriole, and the desert spiny lizard. Another species, the desert night lizard, is heavily dependent on the material provided by downed Joshua trees. Additional communities in the Mojave include isolated islands of Great Basin communities, such as sagebrush and blackbush.

The vegetation of the Colorado Desert is more sparse than that found in the Mojave, and as such, affects the productivity of the associated animal populations. Typical communities are dominated by shrub communities, such as creosote, burrobush and brittlebush, intermixed with tree-dominated washes. These latter areas are particularly important for wildlife, including the wide-ranging species, like the coyote, black-tailed jack rabbit, black-throated sparrow, roadrunner, and Red-Tailed Hawk. Other more specialized species include sidewinders, fringe-toed lizards, and desert kangaroo rats in the sandy areas; the chuckwalla, collared lizard, chukar, canyon wren, and rock wren in rocky habitats; and the zebra-tailed lizards in the desert pavements.

Important wildlife communities of the mountain areas are dominated by forests of pinyon pine, yellow pine, limber pine, bristle cone pine, and white fir. The pinyon-juniper woodlands are important for mountain chickadee, mountain quail, porcupine, and several types of chipmunks. The other forests are important for hole-nesting birds, such as woodpeckers and wrens, and frequently support mule deer herds.

The wetland environments in the CDCA are extremely rare and are very important for wildlife populations. Eight of the 13 officially listed endangered, threatened, or rare species are restricted to these habitats.

2.5.2 Wildlife (continued)

In addition, games species are found here, including bighorn sheep, mule deer, doves, and a variety of ducks and geese. Other species that are commonly found in the surrounding desert also frequent these areas. Major plant communities include mesquite thickets, cottonwood/willow groves, and palm oases.

The playas, dry lake beds, and alkaline sinks contain salt-crusted soils incapable of supporting only a few of the most salt-tolerant wildlife species. However, when the lakes have standing water, the invertebrate populations of fairy shrimp become abundant and provide food for any migrating birds. After the area dries up, the shrimp disappear until wet conditions again stimulate the re-activation of their eggs and cysts.

The dunes are found intermittently throughout the length of the CDCA comprising less than 5 percent of the area. they support common vertebrate species found in other desert habitats, plus certain types of invertebrates found nowhere else in the world. Some species of beetle and butterfly are known to occur only on a single dune.

2.6 CULTURAL RESOURCES

The CDCA holds a variety of precious prehistoric and historic cultural resources. Although much of the land remains to be surveyed, Bureau of Land Management Desert Planning staff and other professionals have identified and recorded multiple resources. These evaluators are viewing the desert in a larger context pointing to the recognition that important natural resources must be used for the national good, but exercising caution to insure that cultural resources which may be impacted will be studied and conserved where necessary.

Cultural resources include archaeological, ethnological, ethnohistoric and historical data in the CDCA and range from evidence of early human habita-

tion and man's early activities to historic mining camps and other resources of more recent vintage.[16-23]

Prehistoric examples in CDCA include cultural remains of early peoples at least 10,000 years in age to turn of the century evidence of partially acculturated peoples. Such places extant include where the American Indian utilized areas for habitation as villages, caves, rockshelters, rock rings, and temporary and open campsites. Other sites occur which have a relationship to hunting, gathering, or food processing such as quarries, milling stations, roasting pits and cairns. Still other locations contain vestiges of activity such as lithic scatter and potter sherds. All of these cross-cut the upland, lowland bajada, and closed drainage basin relief areas.

Man's relationship with and between nature and his religious activities can be found in the physical being of sacred sites such as mountains, burial grounds and cremation shelters. Other early efforts that reflect such relationships can be found in rock alignments, rock art complexes and petroglyphs which may be expressed as perhaps having both creative (leisure) and religious connotations.

The historic era reflects a wide range of human activity since the Spanish contact period, reflecting trails used by Spanish explorers and priests. These often followed earlier trails established by early man or even desert animals. In this fashion, later trails were utilized by mountain men or trappers; for cattle driving; and by the military who used wagon roads and railroads. Highways are also indicators of these earlier cultural resources.

Gold was discovered in the 1860's in the Searles Lake area, for example the Slate Ranges, and later in Randsburg and Johannesburg in the 1890's. In 1910, tungsten was located at Atolia. The Trona Railroad and its construction camp and the famous 20-mule borax team road loom large as landmarks. Such areas reflect a variety of historic mining camp activities including

mining techniques. In a substantative fashion these camps give examples of life on the American Frontier, then the most important commercial activity in the desert as it may be today.

Ethnohistorical studies already carried out in some CDCA regions give added importance to the study of the historic period since the relationship of these individuals to the environment must be fully realized in the context of proposed use of natural resources. A people's heritage in the form of visible sites must be retained.

Other obvious historic sites to be encountered are ranching, water development features and evidence of the U.S. Military. Examples of World War II activites can be found at places such as Camp Young, Camp Irwin, and Camp Ibis where General George S. Patton's tanks and troops left evidence of their training behind.

The significance of all these cultural resources is that some of them are priceless and irreplacable, while others which we are aware of are fast disappearing, and unquestionably, there are still others about which the scientist knows little.

3

ENERGY AND MINERAL ACTIVITIES

3.1 HISTORICAL BACKGROUND

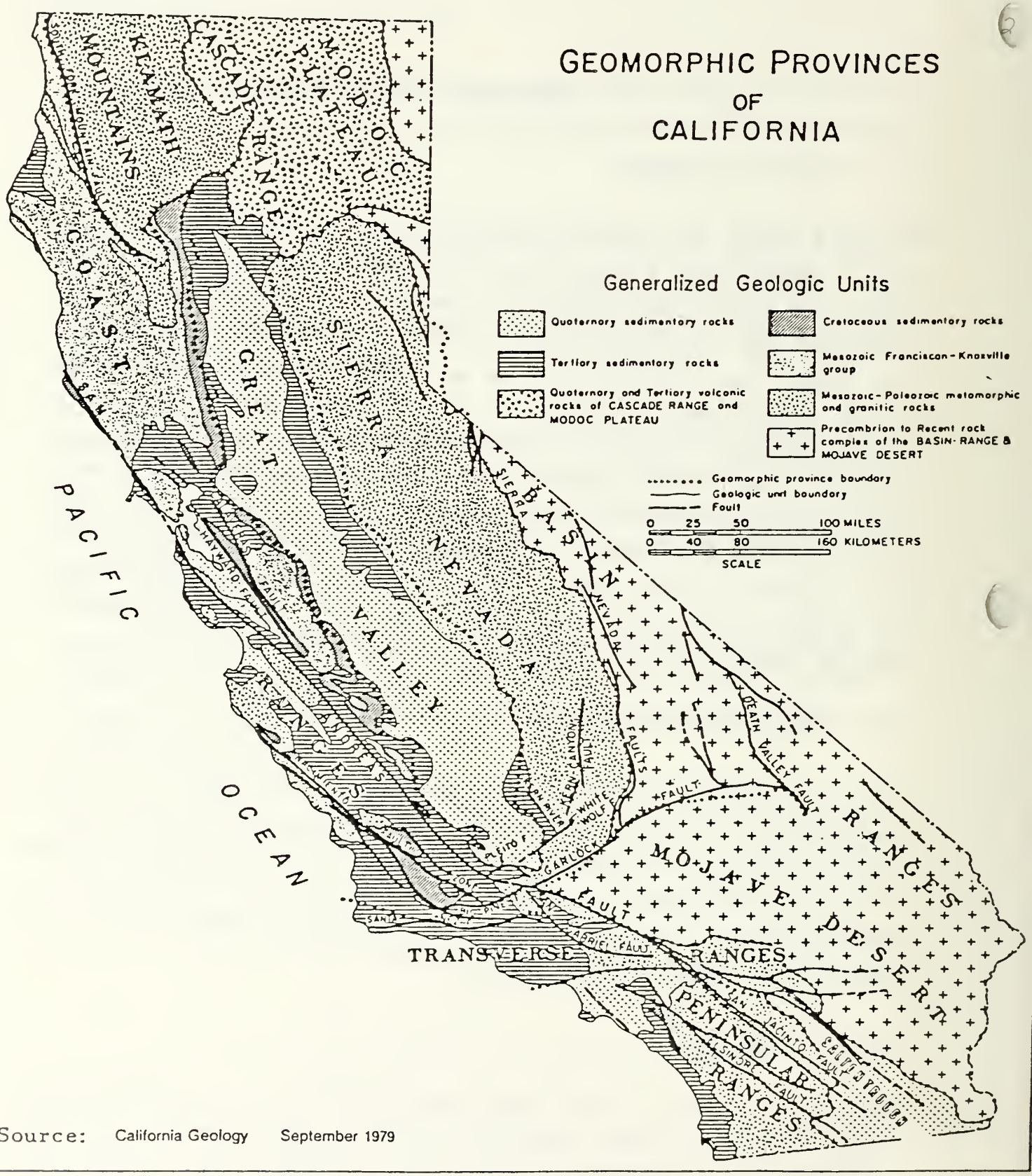
The CDCA region of California has proved to be a veritable "Treasure Chest," stocked with a wide variety of mineral resources. One hundred years of extensive development and operation, ranging from the burro prospector with his pick-and-shovel mine to sophisticated chemical extraction plants, has served to pile up an impressive production record and outline a wide range of resources in a resource inventory. This inventory ranges from known deposits or reserves developed from known prospects and exploration targets, to potential, yet-to-be discovered deposits. Company ownerships extend over all these categories, but most of them cover mining reserves and potential ore bodies in established mining districts. Larger areas of mining claims and all conjectured undiscovered deposits are chiefly in the public domain and, hence, are the chief concern of planning studies such as this one.

3.2 ENERGY RESOURCE ACTIVITIES

Due to the projected increase in mining-related requirements for housing and associated service infrastructures, the "in-the-ground" energy possibilities need to be considered. Geothermal search is already well covered by the U.S. Department of Energy, and various private operations have on-going projects. No coal deposits are found in the area, but oil, gas, and uranium research is being conducted.[24-33]

3.2.1 Oil and Gas

California's Desert, in the southern part of the state, is a continuation of the larger Basin Range Province of the Great American Desert, as shown in Exhibit 3-1. The Mojave Desert is an inter-mountain basin filled with recent alluvial deposits from the Pleistocene, covering small mountain



Source: California Geology September 1979

3.2.1 Oil and Gas (continued)

ranges and lapping against the slopes of many others. This general sedimentary format provides numerous favorably looking anticlines and stratigraphic trap situations to capture migrating oil and gas should there be any source beds in the vicinity. However, the marine source beds customarily associated with hydrocarbon and petroleum formation are not expected at depth in the CDCA.

Nevertheless, there have been a small number of drilling "plays" over the decades based on numerous possibilities. These drillings are mostly at the caprice of promoters and leasehold merchants and not conducted by major oil companies. During a drilling, the operator will typically encounter methane bubbles from shallow vegetal detritus, then basement rocks and disappointment. Most of these wells range between 2,000 and 3,000 feet in depth and provide valuable geological data. All of them drilled in the CDCA are shown on a set of three Wildcat Map Sheets issued by the State Division of Oil and Gas and revised as of 1 July 1978.[34] They are aptly sub-titled "showing wells not on Division (producing) Field Maps."

Possible oil and gas leasing activity at greater depths is presently rumored for the eastern end of the Mojave Desert. This possibility results from three years of drilling activity, which caused large acreages to be leased from Canada southward through Idaho, Wyoming, Utah, Nevada and Arizona. Initial exploration and deep drilling in 1974-75 in the Wasatch Mountains of the Utah-Wyoming state-line led to the discovery of high-production oil and gas, occurring in basins between 12,000 and 15,000 feet in depth. These basins are seismically obscure and located under a massive thrust block that may have moved a distance of 50-to-100 miles to cover unsuspected sediments, with great thickness and good prospects for oil discovery. Developmental drilling and additional wildcat wells have brought in a dozen fields, all with substantial reserves and high potential production rates. Production from the area, as a whole, was reported

3.2.1 Oil and Gas (continued)

in the summer of 1979 at 21,000 bbls/day. The southern end of the play in Arizona is currently phased in seismic exploration and additional land acquisitions.

Rocky Mountain petroleum searchers for many years have worked and believed that basement depths ranged between 8,000 and 10,000 feet. This precluded further thinking "in depth." However, the discovery of new and prolific oil horizons below that point adds a great new dimension to potential discoveries. Geological premise today, supported by 4,000 miles of seismic profiling by the major leasing oil companies, supports a great crustal craton or rift that underlies the Rocky Mountains generally from Mexico northerly into Canada and Alaska, which likely started in the time of the Laramide Revolution. This rift brought about great shifting and over turning of land masses to create the "overthrust areas" that are coming to light in the present explorations.

The Utah-Wyoming discoveries have generated an active "Alberta Overthrust" leasing and drilling play. At the southern end of this activity in the Arizona desert southwest of Phoenix, several wildcat wells have been drilled through the previously accepted "basement point" to encounter some 4,000 feet of salt, annyhdrites and marine formations in unsuspected stratas concealed by thrust plates.

Nevada is centered in the general play of exploration and while there has been a reasonable amount of exploration and wildcat drilling, the possibilities are comparable to other locations along the western mountain front. Encouragement for Nevada also comes from the small Railroad Valley Field which has produced heavy oil at a small but steady rate to total over 3.0 million bbls. in 20 years. In Southern Nevada, current plans call for deep drilling near Las Vegas.

The highlights of the Overthrust Play have been outlined here for their possible impact on the adjacent desert regions in the CDCA area. If the

3.2.1 Oil and Gas (continued)

potentials are sufficient for active drilling plays in Northern Mexico as predicted, the desert regions of Southern Arizona and California could receive some of the same leasing and drilling action.

3.2.2 Uranium

California has had a modest uranium production record, made under the impetus of the uranium search of the 1950's. Several small production mining operations, chiefly in the western end of Kern County in the Kern River Canyon, shipped a total of 400 tons of uranium ore to the Vitro Chemical Mill at Salt Lake City between 1954 and late in 1957. The grade of ore ran from 0.16-to-0.67 percent U_3O_8, according to C.D. of M & G Kern County Report. The same source states, "Anomalous radioactivity was detected in many tens of localities in Kern County, but only a few of them appear to have warranted more than shallow exploration." Elsewhere in the CDCA region, the Coso Uranium Co., near Inyokern, shipped 300 tons of low-grade uranium ore in 1956, per the State Report. Other shipments made from California were "hundreds of tons of low-grade ore" from Hallelujah Junction north of Lake Tahoe to the Salt Lake City milling facility.

Some of the uranium explorers of the 50's noted that uranium minerals were emplaced from "rising spring waters." This possibility supports the thesis that there might be heavier concentrations of uranium at deeper levels, such as in the brines of playa deposits. This thesis is presently being worked on at Owen's Lake where it is reported that "they have been doing deep drilling each season." Uranium exploration is also reported for Searles Lake and the general Trona District. If there should prove to be deep-level uraniferous strata in these areas, it would provide a possible application for solution mining, provided sufficient water is available.

3.2.2 Uranium (continued)

In addition, a radiometric aerial survey over the greater desert regions was conducted for the BLM with the intended result of evaluating energy and mineral potentials. These results are presently being analyzed, and they may improve our knowledge of the desert's resource inventory.

3.3 MINERAL RESOURCE ACTIVITIES

The mineral activities in the CDCA have been quite extensive and varied over the last one hundred years. Over 251 mining districts and/or mine groups have been developed from these efforts. Not only do these areas represent present and past activities, but they also represent probable sites for future activities. This probability is borne out by the expansion and exploitation carried out on existing sites over the last hundred years.

The most commercially successful mineral to be extracted from the CDCA has been borax, or borates. Over $1 billion in this product has been removed from the Kramer Mine in Kern County. This amount reflects the cumulative total of sales, noted at the dollar value when production occurred. If inflation is taken into account, this amount would be even more phenomenal.

Another major mining operation in San Bernardino County, located at Searles Lake, has produced sizable quantities of borax, potash, and lithium from lake brimes. Its cumulative production totals are listed between $100 million and $1 billion. The Eagle Mountain Mine in Riverside County also produces iron in this same value range.

Other mines and districts have produced metal commodities in the range of $10-to-$100 million. These operations are listed below:

- Cerro Gordo Mine in Inyo County---lead, silver, zinc, gold, and copper.

- Darwin Mine in Inyo County---lead, silver, tungsten, and zinc.
- Mountain Pass Mine in San Bernardino County---rare earths and barite.
- Randsburg District in Kern County---gold, silver, tungsten, manganese, and talc.
- Creal Quarry in Kern County---limestone and quartzite.
- Sweetzer District in San Bernardino County---feldspar, gold, and silver.
- Calico District in San Bernardino County---silver and barite.
- Victorville District in San Bernardino County---gold, silver, sand, gravel, and stone.
- Cushenbury Quarry in San Bernardino County---limestone.
- Bristol Lake in San Bernardino County---calcium chloride, salt, gypsum, and barite.
- Imperial Gyps Mine (Fish Creek Mountain) in Imperial County---gypsum.

Other minerals that have been extracted from the CDCA include sulfur, asbestos, clay, bentonite, colemanite, pumice, fluorite, mica, sodium carbonate, magnesite, opal, wollastonite, celestite, cinders, perlite, turquoise, dolomite, marl, strontianite, pyrophyllite, soapstone, marble, mercury, sodium sulfate, bismuth, monazite, calcite and gemstones.

3.3 MINERAL RESOURCE ACTIVITIES (continued)

All minerals found within the 251 mining districts and mine groups are further described in Appendix A. Specific data in this table includes name, county, map location, commodity and past production sales.

3.4 FACTORS AFFECTING FUTURE RESOURCE DEVELOPMENTS

A projection of the mining activities in the CDCA 20 years from now can be based on an analysis of several parts of the energy and mineral resource base. This base may be measured in terms of continued industrial growth and market demands. It can be separated into various categories:

1) Known reserves: Development ore potentials of working mining operations. Companies maintain their "ore ahead" through their own geology departments and by off-property acquisition to maintain their profitability and provide for future contracts.

2) Metallurgical reserves: Presently unworkable deposits that could become ore bodies through developing technology in areas such as flotation, ion exchange, solution mining, etc.

3) Low grade deposits: Many deposits are known, measured, and held by companies. Their exploitation awaits large-scale, low-cost mining methods such as open-pit porphyry coppers or the rise in market prices, or improved transportation such as the construction of a railroad spur. Market factors also play a role; for example, the formidable rise in gold prices that have allowed three custom gold mills to be currently active in the Mojave region. Also, the increasing demand for uranium has placed pressure on its exploitation.

4) Outside factors: World economic and political conditions can affect the CDCA. One example is provided by the Defense Mineral Subsidies of World War II which focused on manganese,

tungsten, and vanadium exploration. The program was subsequenty extended for some years and supported further exploration. Research in other industries has created new demands such as the development of color television which created a demand for rare-earth oxides that completely restructured Moly-Corp's mine and mill at Mountain Pass, quadrupling its output. The research that created this demand was provided entirely by the electronics industry.

4 IMPACT SCENARIOS

4.1 INTRODUCTION

A mining operation can be considered to have a life cycle beginning with the recognition of favorable geologic and economic conditions and progressing through stages of exploration, development, production, and reclamation to final abandonment. The life cycle may be relatively simple, but more often it is complicated by superimposed cycles of expansion projects, new directions in engineering, rejuvenation, and even geologic or economic resurrection. As a matter of special importance to the impacts on the environment, most potential mines are never born; exploration may last for years and may even be an intense or repeated process, without ending in a productive operation. For the purpose of the California Desert Conservation Area study, the simple view is taken; a mining operation goes from exploration to abandonment in a single cycle.

4.2 METHODOLOGY

As mentioned in Chapter 1, the purpose of this study is to provide government planners with technical information that enables them to improve their ability to plan for future mining developments. Since this is a theoretical exercise, models had to be constructed to provide examples of what a mining scenario might look like and how it might interact with the environment. The process was begun at Riverside, California, in October 1979 where government experts from the Desert Planning Staff met with Omniplan consultants. This group selected three environments that they felt were typical of the CDCA and although none of them actually represented specific geographical locations, they did represent a composite of environmental components from similar types of habitat in the CDCA. Similarily, the research team developed six candidates for mineral resources that could be mined in these model environments. Two of them were designated to

occur in each of the three environments. From this mix of model resources and model environments, impact scenarios were developed.

The text that follows describes the impact scenarios according to a description of the three model environments, the six mining resource models, the six most economical mining processes associated with the resource models, and the impacts that would be expected to result from these activities. The discussion is organized within the context of the upland, lowland bajada and closed drainage basin habitats. All information is then summarized in a six-page impact matrix.

4.3 UPLAND ENVIRONMENTAL SCENARIOS

The Upland environment occupies mountainous terrain that varies in elevation from 5,000 to 11,000 feet. Its soils occur in steep, excessively drained areas that contain numerous bare outcrops, particularly limestone. Typical soils are shallow, with surface textures ranging from very stony to sandy. The value of these soils for agriculture is very slight. The Upland geology includes all of the major rock types that are noted in Chapter 2, Regional Environment. Older, more deformed rocks predominate in the Uplands. They are quite hard since their resistance to erosion was a major factor in creating the Uplands. Limestone is an abundant rock type here, and it is not nearly as well exposed or accessible in lower environments. The hydrology of the Uplands is reflected by several small streams that join one of the CDCA's major rivers nearby. The biological ingredients for this environment include communities that are associated with pinyon pine; mixed pinyon pine and juniper; and mixed pinyon pine, juniper and white fir. Common wildlife found within these zones include mountain chickadee, mountain quail, woodpecker, wren, chipmunk, porcupine, and herds of mule deer.

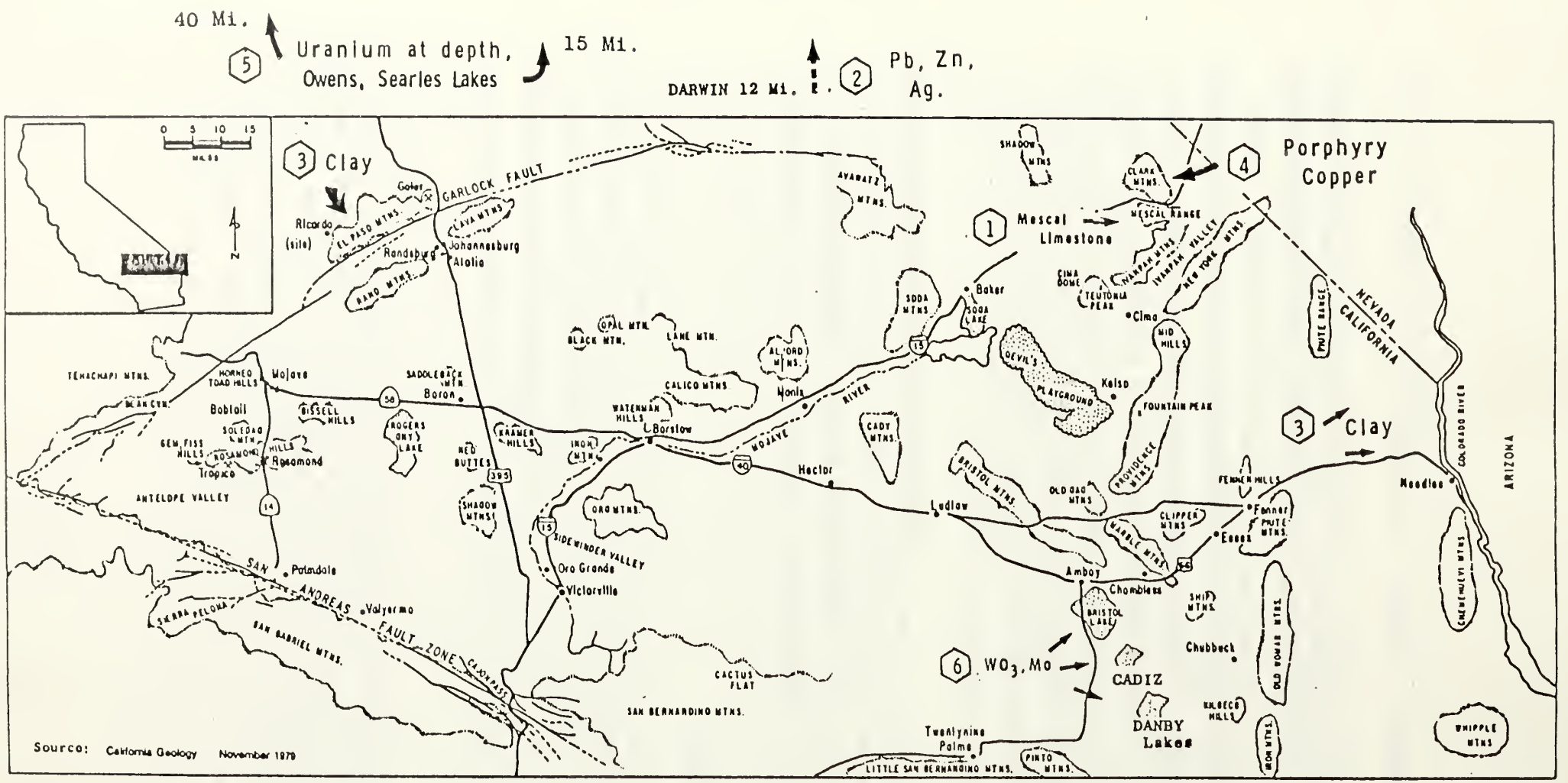
In this environment, prehistoric sites appear to be clustered near permanent water sources; permanent water is a good predictor of historic sites as well. Deer spring might be one area of particular interest. Desert bands utilized desert vegetation, fresh water marsh foods and the woodland plants for subsistence. They also hunted and took both vertebrate and invertebrate foods. Eastern Mojave tribes, which included the Southern Piute, Chemehuevi and certain bands such as the Providence Mountain bands, made both homemade and trade pottery. Caves, rockshelters, rock rings, roasting pits, workshops, milling stations, lithic quarries and rock alignments also add to the area's resources.

Rock art is considerable in the region; mid-hills and such peaks as Kessler are possible areas of likely prehistoric sites. In mountain prehistoric sites, a large percentage of those in the pinyon/ juniper stands are habituation, but habitation sites are also dense in valley bottom areas.

4.3.1 Model Resource I

The first model resource for the upland habitat is limestone. There are nearly one hundred bodies of limestone that are outlined and well-known in the greater desert region, all of which await future demands for development. Thoughts of a new cement plant are presently ruled out because of greatly escalated capital costs and the ability of existing plants to expand.

However, a limestone quarry and grinding plant to supply specification limestone to the Los Angeles industrial area would be economically feasible especially if located on or near good transportation routes. An example would be a deposit that lies south of Highway 15 at Mountain Pass and a short distance north of the Union Pacific Railway at Cima, as shown in Exhibits 4-1 and 4-2. It is described by Bowen and Gray in C.D.M. & G. Bulletin 194 as follows:



UPLANDS

1. Mescal Mt. Limestone, Cima on U.P.Ry.
2. Replacement Pb, Zn, Ag Darwin vicinity

LOWLAND BAJADAS

3. Clay - El Paso Mts. and Needles Region
4. Porphyry copper, Clark Mountain

PLAYA DEPOSITS

5. Uranium at depth, Owens, Trona Lakes
6. WO_3 and Mo in brines - Bristol, Cadiz, Danby Lakes

EXHIBIT 4-1
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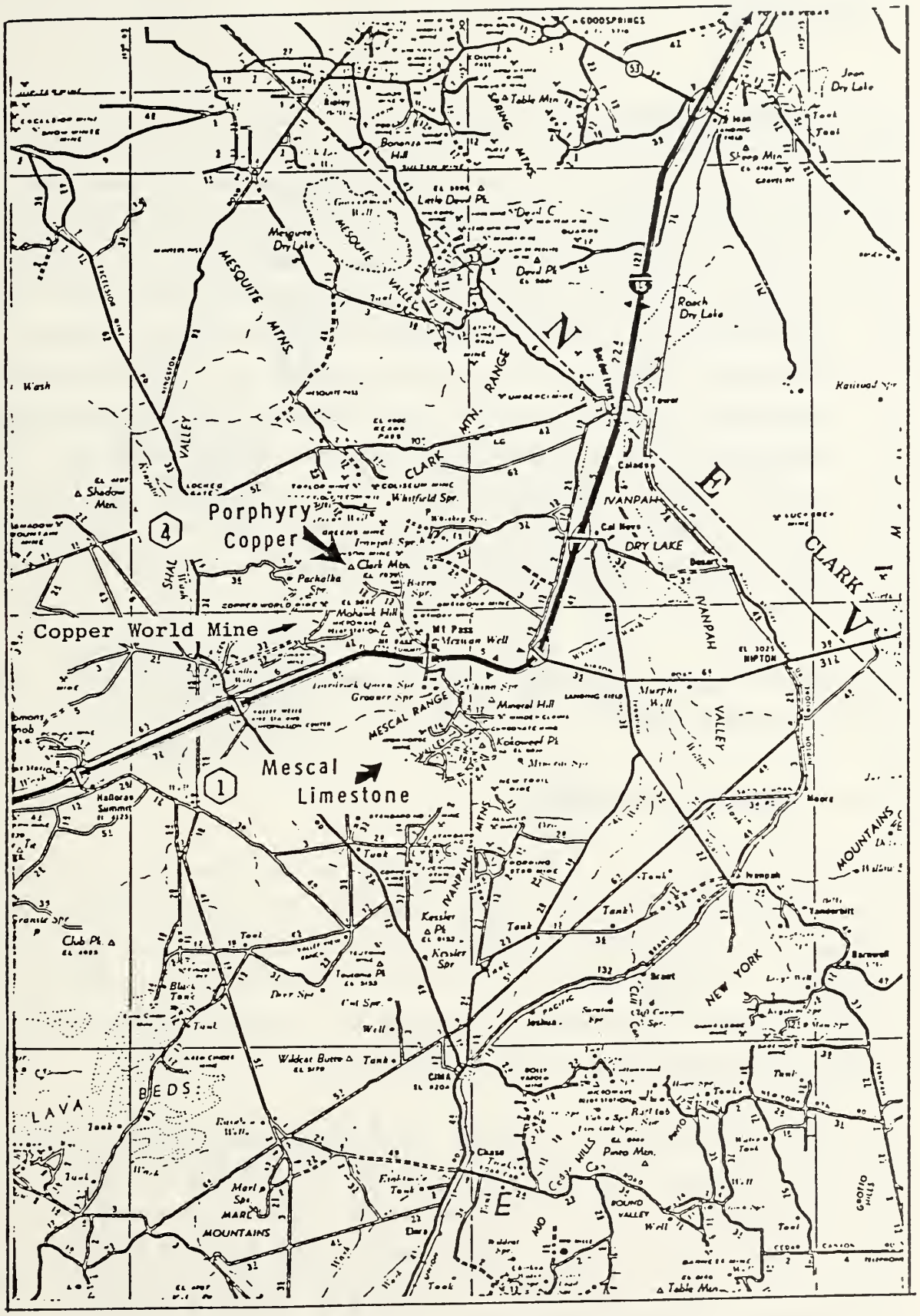


CLARK MOUNTAIN REGION

4.3.1 Model Resource 1 (continued)

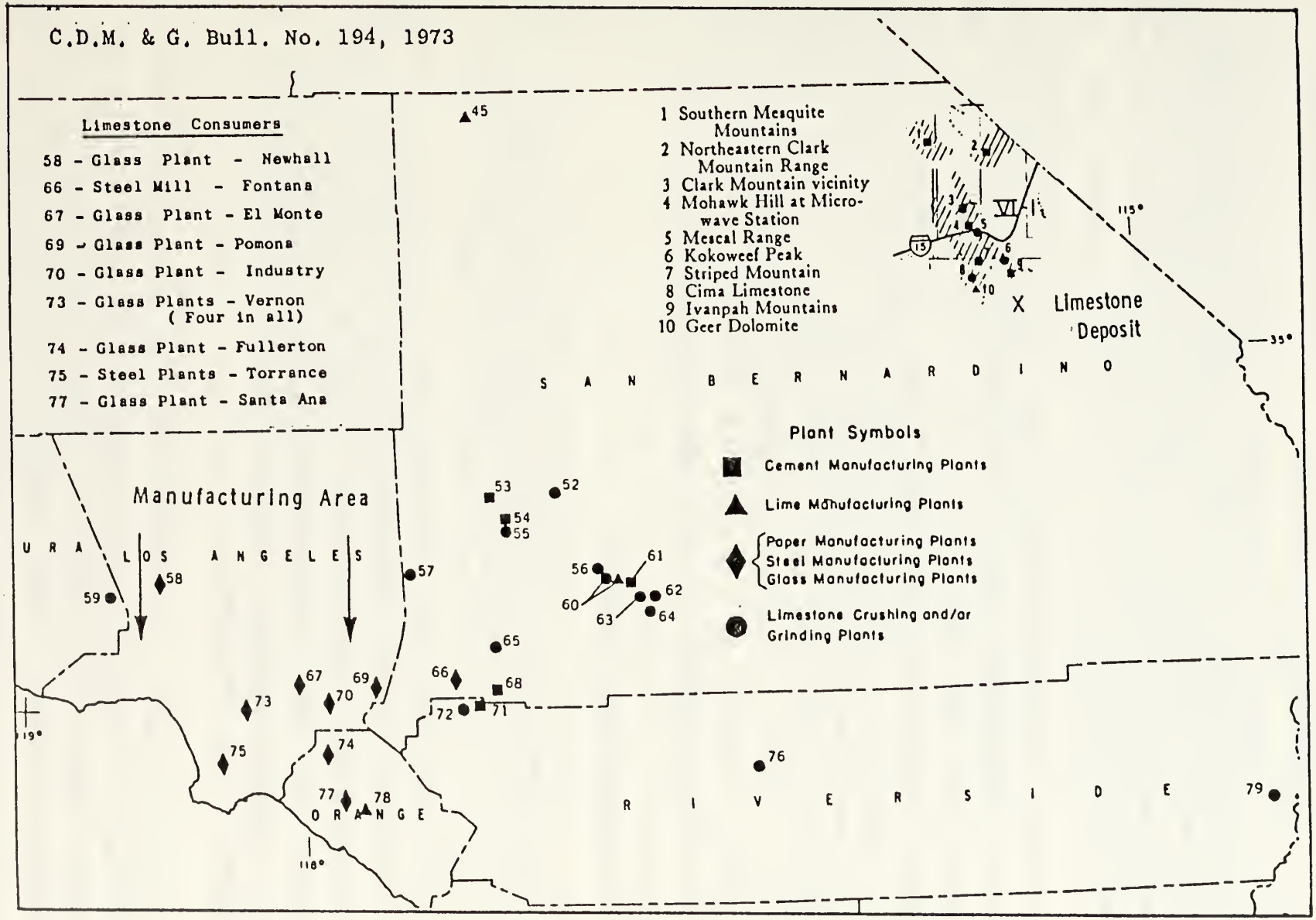
The Striped Mountain area of the Mescal Range in north-eastern San Bernardino County lies within 12 miles of the Union Pacific siding at Cima and 3 miles east of Cima Road. Immense reserves of both blue-gray and white limestone of good grade are exposed over favorable quarry terrain. The Bullion Member of the Mississippian Monte Cristo Limestone, The Crystal Pass Limestone Member of the Devonian Sultan Limestome, and certain parts of the Cambrian to Devonian Goodsprings Dolomite are the most promising objectives. Large masses of fine-grained, non-decrepitating high calcium limestone are available that can be competitive with rock currently imported from Nevada. (Cima Limestone, Geer Dolomite, and Mescal Range---Clark Mountain, Ivanpah Mountains.)

The data on deposits and manufacturing plants and markets from the plates of the quoted Bulletin 194 make up Exhibit 4-3.

4.3.2 Model Mining Operation 1

Exploration efforts for a limestone quarry and grinding plant would represent the first phase of the mining operation. They would probably be minimal since the quarry would most likely be located in or near known reserves. A minimal amount of drilling could be necessary, perhaps requiring access jeep trails and blasted drill or bulk sample sites. Total cost of discovery could be less than $100,000.

The total system would be designed to process 20,000 tons of crushed limestone per day. The quarry would probably be located on a hill, eventually occupying an area of 0.5 square miles. If revegetation is possible in the area, the top foot of overburden would be stripped and saved for restoration. Major facilities would include a crushing plant and a loading and shipment building. One power line with a rating of at least 100,000V would be required to service the major facilities, especially the power-



GEOGRAPHY OF LIMESTONE OPERATION

Source: LIMESTONE AND DOLOMITE PROCESSING PLANTS IN CALIFORNIA
Compiled by Oliver E. Bowen

0 10 20 30 40 50 Miles
0 10 20 30 40 50 60 Kilometers

EXHIBIT 4-3
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4.3.2 Mining Operation I (continued)

intensive crushing plant. The power line could be as long as 60 miles and would be located above ground. A two-lane road, approximately 40 miles in length, would also be required. No permanent project camp would be needed during the 10-to-20 year life of this operation.

As mining is completed in specific areas, reclamation activities could commence in conjunction with active mining processes. Land forms would be restructured to approximate contours typical of the general region, even though total elevation levels would be less. Check dams would be placed at the lower points, in order to collect and slow down water that accumulates during and after infrequent precipitation events. Since revegetation is difficult to artificially induce in desert regions, it may not be undertaken. However, if it is done, the transplanting of shrubs or artificial seeding by injection could be acceptable techniques. Supplemental water would also be desirable and fertilizers would probably not be used.

4.3.3 Model Impact Scenario I

Since a minimal amount of exploration activities are expected with this mining operation, the impacts are projected to be low and short term. Categories receiving such impacts would be land surfaces, air quality, water quality, water usage and native flora. The land surface disturbances could result from small prospecting pits 150-to-200 cubic feet in volume, jeep access roads, and bladed areas for drilling covering 150-to-200 square feet. Slight water quality changes could occur from limited chemical contamination; some fugitive dust would be generated and small areas of vegetation would be removed.

During development, about 1,000-to-1,500 acres of overburden could be stripped, which would have a high impact on fugitive dust generation, floral removal, faunal disruption, land use, plus potential cultural resource disruption. Common biological resources that could be affected include mountain chickadee, mountain quail, woodpecker, wren, chipmunk,

porcupine and herds of mule deer. Endangered plants and animals could also be present and adversely affected. Loss of several kinds of prehistoric sites could also take place---habitation sites and workshops. Surface evidence could disappear, making it impossible to recover data related to sites. Rock alignments have already been lost in the CDCA and others could be destroyed by vehicular traffic. A high loss may also be expected of temporary sites, lithic scatter areas and older trails. The use of shovels and trenching equipment may also be initially detrimental.

The ore waste removal could involve the use of 300-to-1,500 additional acres during the production phase and would have a high impact on the same categories affected during development. The duration of the impacts would be at least as long as the mine is active. The impacts on biological, and possibly cultural, resources would last much longer.

Effects on water would probably be minimal for the limestone quarry. Groundwater in the area would already contain dissolved calcium and magnesium salts, due to contact with the rocks being mined. Yet, some suspended fines and clays might accompany processing waters, if dry processing is not used. In addition, soluble reaction products from rock-blasting agents could be anticipated in water drained from mine areas.

After mining commences, above-ground work with crushing facilities, flotation mills, tailings ponds and monitor wells can cover up cultural resources by spreading out the process material over them. Consequently, general plans should be submitted before any activity takes place so as to preclude activities that will damage artifacts and compact deposits. Once a mining plan is approved, field reconnaissances should be made to utilize the BLM sensitivities determination process.

In such sites as quarries, workshops and temporary campsites, the recording of sites and the recovery of artifactual evidence may be adequate. Similarly, cairns, milling sites, roasting pits, rock rings and rock alignments

4.3.3 Model Impact Scenario I (continued)

could be documented. In some cases, the National Register of Historic Places should be consulted. Furthermore, it might well be that rock-shelters, caves and other more permanent sites should be excavated and the recovery of data made in detail. Certainly, rock art---petroglyphs---should be protected in situ.

For historic landmarks or sites, the location and condition of sites must be considered as relevant to their retention. In some instances, perhaps an historic road or trail can be maintained, appropriately recorded and marked. Inscriptions by pioneers on rocks and more permanent sites should be retained, particularly if their significance is determined. Very special attention must be given to historic mining camps to insure that they can be preserved without destroying live communities. Fortunately, the possibilities are great that the company who began the operation could also protect and preserve some significant phases or structures. They could also commission the documentation of histories for such areas as a contribution to our national heritage.

The reclamation activities would impact the same categories affected by development and production although its purpose would be beneficial restoration.

4.3.4 Model Resource II

The second model resource within the upland habitat is a lead/zinc/silver deposit. An example of such a deposit may be found in the Darwin area. The Darwin area deposit is located in the northern end of the Argus Range and is a typical silver/lead/zinc sulphide replacement deposit in a contact metamorphic or skarn/tactite area of mineralization. Two periods of early day sulphide mining yielded $8 million production. The Anaconda Company acquired the properties in 1945 and in the next decade produced ore worth $18 million. Large portions of the upper ore bodies were highly oxidized, and Anaconda developed an acidizing step in the mill circuit that made oxide ores amenable to flotation recovery. A moderate amount

4.3.4 Model Resource II (continued)

of tungsten has been produced, mainly as a by-product. The most recent activity here has been the shipping of some of the stockpiled tungsten ores.

4.3.5 Mining Model Operation II

The exploration activities for a lead/zinc/silver mine could be conducted as part of a larger search to find valuable mineral resources in the CDCA. Even so, as much as $1 million could be spent per year, using the talents of two or three geologists and several support personnel to conduct the studies. Air and ground reconnaissance and drilling would be required. After discovery, these actions would enable the geologists to properly locate the most suitable areas for mining. The procedure would involve the establishment of several temporary drill sites, which could be serviced by helicopter, flying in equipment to minimize environmental disturbance. Studies and the test drilling of candidate sites might continue for a decade.

The model resource itself would be a skarn-bedded replacement ore deposit. It would be mined at an extraction rate of 1,000 tons per day, five or six days a week. The deposit would contain about 6 million tons of proven-probable reserves, and it would contain sulfides with local minor oxidation. The mine would be of the room and pillar variety. It would be a trackless, diesel-powered mining system with access by a spiral ramp decline. The mill would use the flotation process and would be active for six or seven days per week. It could be expected to recover over 80 percent of the silver and zinc and over 95 percent of the lead.

The capital cost for the mining and milling operation would be over $12 million in 1979 dollars. It would be projected to operate for 20 years, with 150 employees at the mine and adjacent facilities and 20 at the mill, working 2 1/2 shifts. An additional ten people would be employed in an

4.3.5 Model Mining Operation II (continued)

engineering and administrative capacity. Some additional employment at the company's head offices located elsewhere would be predicted. A small camp might be anticipated with a general store and filling station. The principal reclamation activities would be directed to recontouring and blending the tailings piles into surroundings. Artificial revegetation would probably not be undertaken due to the harshness of the environment.

4.3.6 Model Impact Scenario II

The impacts of exploration for this operation would be low and short term, even though there could be more activity than would be expected with the previous operation. The development of the underground mine and the surface plant would involve the disruption of about 200 acres of land. This activity would have concomitant effects on water quality, water use, flora, fauna, land use, and possibly cultural resources. At the surface, the biological and cultural impacts would be long term while underground, the water quality impacts would also be long term.

During production, about 100 additional acres would be used for stockpiling of mined ore, disposal of mine waste, beneficial processing, and tailings disposal. The effects of discharged mine waters would be similar to those cited for the limestone quarries except smaller. Of some concern would be effluents from processing, which require many gallons of water per ton of ore. For example, mill reagents in a typical froth flotation plant could include sodium carbonate or calcium hydroxide in amounts of several pounds per ton of ore treated; plus much smaller amounts of flotation reagents such as sodium xanthates, potassium xanthates, and dithiophosphates; depressing agents, such as chromates and/or sodium cyanide; synthetic frothers; natural oils, such as pine oil; flocculants; and dispersing agents. Typically the cyanide from the depressing agent reacts rapidly with iron and copper species, and does not appear in measurable amounts in water. The flotation reagents or collectors largely accompany the concentrated ore, but excess amounts can appear in discharge waters. Small

4.3.6 Model Impact Scenario II (continued)

amounts of chromates may also appear, if these reagents are used. Discharge water typically is alkaline, but may become acid through reaction with fine-grained pyrite.

Discharge waters and accompanying fine-grained materials typically are contained in slime ponds, which allow solids to settle. Eventual discharge from such ponds may contain dissolved zinc and copper, on the order of 1 to 10 mg/1, in addition to traces of reagents. Lead and other species typically are rather insoluble, and do not appear in significant amounts. Mercury might reach 0.003 mg/1 in concentration , but typically is less abundant. The over-all environmental effect of mills of this kind elsewhere has proven to be minimal. Xanthates, the most widely used reagents, have low LD 50 values (0.5-1 g/kg body weight) for rats, but may be toxic to fish. Fortunately, they are reported to biodegrade rapidly.

Other long-term major effects would occur to biological and possibly cultural resources, and land use. Common biological resources that could be affected include upland birds, chipmunk, porcupine and herds of mule deer. Endangered plants and animals could also be present and adversely affected. Potential cultural impacts would involve the possibilities outlined in the previous section. Reclamation would especially affect the biological resources and land use affording an opportunity for partial biological recolonization and urban and/or recreation land use.

4.4 LOWLAND BAJADA ENVIRONMENTAL SCENARIOS

The lowland bajada environment occurs on the rolling hills and desert pavement at elevations from below sea level to 1,000 feet. Alluvial fans are common features. They are arid except when occasionally washed with torrential summer rains. Again, the geology contains all the four major rock types mentioned in Section 2. The soils are highly varied with notable differences between the rolling hills, with shallow to moderately deep soils and dissected fans and desert pavements, and with well-drained loamy sands, stratified clay loam, and abundant caliche. Typical soils

occurring in nearly level areas include light brownish gray, slightly hard, moderately alkaline surface soils with strongly calcareous sandy subsoils. Elsewhere the soils are brown, platy, mildly-alkaline, loamy surface soils located over reddish-brown, slightly acid clay loams subsoils. Limited grazing occurs in areas where rainfall is ample to produce forage.

The plant life of the area can be found in the major habitats such as acacia tree washes; washes with smoketree and acacia tree mixed together; desert willow washes; and riparian or river environments. This latter environment is especially important because it is rare and extremely valuable for wildlife. Common wildlife of the bajada includes ground squirrel, mouse, jackrabbit, Gambel's quail, mourning dove, raven, various song birds, speckled rattlesnake and desert horned lizard.

Archaeological work already done in the Red Mountain area reflects a large number of milling stations, suggesting a close relationship between available milling stones and certain rock formations. Rock art predominates in this environment near springs and in multiple land form areas. Other resources to be found here are rockshelters, villages, and temporary campsites. Hunting and gathering sites, roasting pits and evidence of lithic activities are also indicative of this region. In addition, religious shrines and sacred locations can be expected to be found, particularly in the Red Mountains. The time sequences for these activities suggest questionable projectile point cultures from as early as 10,000 years ago and late prehistoric cultures from as recent as 1000 A.D.

A variety of more recent activities took place in the desert bajadas, each dependent on a different set of natural resources, for example, mining on mineral deposits and homesteading near the water resources. Spaniards, including Padre Francisco Garces, crossed the region in 1776. Gold was discovered in this region in 1863. Mining was developed in the El Paso and Red Mountain area, concentrated at Johannesburg, Randsburg, Atolia and

Inyokern. This activity included the extraction of borax, gold and silver, and involved considerable human activity in the construction and operation of townsites. The Southern Pacific Railroad line served as a transportation line for these developments, following an earlier pass or trail begun by early man.

4.4.1 Model Resource III

The first model resource in the lowland bajada habitat is specialty clay. The desert clay deposits are stratified bodies of alteration products from volcanic pyroclastics, reworked alluvials accumulated in lake beds, worked down alluvial fans, etc. All clays are alteration products of former heavier minerals. Bulk clays are washed, screened, and "cleaned up" to yield a variety of products which include firing clays, drilling mud, etc. Specialty high-priced clays, when found, include clinoptilolite, chabazite, zeolites, Hectorite,[1] etc. They are in demand for water softeners, adsorbents, drying agents and a variety of industrial cation and anion exchange applications.

An example would be the bentonitic base clay of Pliocene Age that occurs in the El Paso Mountain region, as shown in Exhibit 4-1. It has seams ranging from a few feet up to 80 feet in thickness located in an outcrop that is some 18 miles long. Several clay mines have operated here in the past, and two of them are currently working. However, a new operation could be located on available ground in the vicinity of the Snow White Mine.

An alternate location would be an available 8-to-10 sections of Southern Pacific land in the Dead Mountains a few miles west of Needles. Here, bentonitic drilling-mud quality clays in beds from 70-to-80 feet thick could be readily processed and supplied to both truck and rail shipping.

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[1] Found near Hector, California, near a siding of the Santa Fe Railroad.

4.4.2 Model Mining Operation III

A specialty mine would be set up to extract and bag zeolite, a product that is used in the pollution abatement industry. The exploration phase for this mine could take several years. Several people would be required to conduct the survey, which would involve air and ground reconnaisance and drilling. Drilling and sampling would be similar to, or more extensive than, the program for a limestone quarry. Total cost could range from $100,000 to $1,000,000 to complete the survey and develop the mining plan.

Typically, the mine would be an open pit system, designed to operate for at least ten years. A total area of 0.5 square miles might be affected. It would use two shovels, costing from $250,000 to $500,000 each, and six-to-eight 50-ton trucks, costing about $200,000 each. The total complex would contain a crushing plant and a bagging plant, costing around $3 1/2 million. Other facilities would include an office, warehouse, and truck shop. In addition, a drying facility could also be required, in order to properly process the project for market requirements. Such a facility would probably be powered by oil or gas since no major coal fields are in close proximity. In order to service the electrical requirements of the entire operation, a power line would be needed. Such a line would be above ground, running for 40 miles and having a capacity of 10,000 volts. An additional service road of about 60 miles would be required. As portions of the mine are being retired, they can be recontoured. After operations cease, the entire 0.5 square miles of site will be recontoured.

4.4.3 Model Impact Scenario III

The exploration phase for the clay mine would involve short-term low-level impacts associated with several drilling pads, prospecting pits, and jeep access roads. Impacts would occur in the categories of land form disruption, air and water quality, biological and possibly cultural resources.

4.4.3 Model Impact Scenario III (continued)

The area for the mine and plant would involve approximately 200 acres and an additional 100 acres would be needed for waste disposal. The major impacts from developing, mining and reclaiming this area would occur for land use, biological, and possibly cultural resources. Common biological resources that could be affected include ground squirrel, mouse, jack-rabbit, Gambel's quail, mourning dove, raven, song birds, speckled rattle-snake and desert horned lizard. Endangered plants and animals could also be present and adversely affected, especially any species associated with rare bajada aquatic habitat. Potential impacts for cultural resources would be the same as outlined for 4.3.3 Model Impact Scenario I.

Moderate long-term impacts would also be expected for air and water quality. Water effluent from this operation can vary from almost none, in the case of an open pit specialty clay producer, to extensive, in the case of a plant using process water. Principal solids in the water can include fine-grained clay, talc or fiberlike particles. Principal dissolved constituents, in addition to reaction products from blasting agents, can derive from soluble salts accompanying the material being mined. Air quality impacts would occur from fugitive dust generation at the tailings disposal site.

4.4.4 Model Resource IV

The second model resource within the lowland bajada habitat is a porphery copper deposit. There are five different potential bulk tonnage copper ore occurrences in the Mojave region that are, to some extent, known and measured. The one under Clark Mountain, as shown in Exhibit 4-1 and 4-2, is the largest. Its known extent is said to total 10 million tons of proven ore, with an additional 10 million tons of potential ore. There is also a small gold content. Another possible copper resource is the old Copper World Mine, located on the northern flank of Clark Mountain. It had an early day production of $1.5 million during two different periods---one before and one after World War II. Its operations included a smelter on the flat at Valley Wells.

4.4.4 Model Resource IV (continued)

The model operation for a porphyry copper ore deposit would be an open pit mine located in a lowland bajada and utilizing wet milling facilities to produce a shipping grade copper concentrate with a possible molybdenum by-product.

4.4.5 Model Mining Operation IV

The exploration phase for this mine would probably be undertaken by a major corporation with sufficient funds to finance a multi-million dollar program. Such a program could be looking for other ores, in addition to copper and molybdenum, and it could be searching for all of them over an area much larger than the CDCA. The total cost of such a program could be upwards of $50 million and it could take as long as ten years. Investigations for the copper/molybdenum deposits would include air and ground reconnaisance and the drilling of strategically-placed initial exploration holes. Such holes might be serviced by helicopters, but if a small series of these holes is required, an access road would be necessary as well. Any promising ore reserve would have to be evaluated with a hundred or more drill holes on 50-to-100 foot centers.

The mine would be designed to produce about 25,000 tons per day although it could increase its output when copper prices rise. The mining process would employ at least a 3:1 stripping ratio and the recovery at the mill would be 0.70 percent copper and 0.10 percent molybdenum. The flotation mill could cost up to $30 million, and the tailings pond, at least $1 million at present prices. A road and possibly a railroad spur would be required, in addition to a heavy-duty power line, water line and several water supply wells. The mill would require as much as ten gallons of water per ton of ore treated, some of which could be recycled.

Ancillary facilities, such as offices and a small camp would be necessary, costing about $1 million. About 20 trucks would be needed in the 100-to-200 ton range, costing $5 million. Four shovels would be needed in the

4.4.5 Model Mining Operation IV (continued)

mine and would cost around $3 million. A pump system to keep water out of the active parts of the mine could cost another $0.2 million. Leach pads and a pump and scrap iron system would cost about $1 million. The total system would be designed to operate for at least 20 years. The reclamation would be a massive undertaking, starting as soon as portions of the site are retired.

4.4.6 Model Impact Scenario IV

The exploration phase for the porphery copper mine could involve the drilling of a considerable number of holes which would disrupt small sites measuring 100-to-200 square feet. Other disruptions could involve the development of temporary access roads and the digging of small prospecting pits. Small, short-term impacts would occur for the categories of air and water quality, water usage, biological, and possibly cultural resources.

The development of mine and associated plant would involve the modification of from 1,000-to-1,500 acres with another 300-to-1,500 acres required for disposal. This activity could develop considerable ground water, modified by materials from the blasting agents and soluble salts from the mine. The processing plant, very likely utilizing the flotation process, could have many of the same effluents as the lead-zinc mill, although chromates and mercury would not be expected. The scale of the porphyry copper mill would be considerably larger than the lead-zinc mill, processing 20,000-100,000 tons/day versus 1,000 to 2,000 tons/day. This plant might also include a process operation to remove copper from low-grade dump rock. This could result in effluent rich in iron hydroxides, and low pH. Prior to mining, groundwater adjacent to such an operation would probably already contain several mg/l of copper, as well as significant traces of molybdenum, zinc, and uranium.

4.4.6 Model Impact Scenario IV (continued)

Other major impacts resulting from this development and production would occur for air quality, water use increases, flora and fauna, land use, and possibly cultural resources. The common biological resources that could be affected are those mentioned in 4.4.3, Model Impact Scenario III; the cultural resources affected are those identified in 4.3.3, Model Impact Secenario I. Additional impacts would occur due to moderate influxes of workers. Those impacts lasting beyond production would include those that occur to land use, air and water quality, and biological and cultural resources.

4.5 CLOSED DRAINAGE BASIN ENVIRONMENTAL SCENARIOS

The closed drainage basin is located at the middle elevations between 1,000 and 5,000 feet. It contains sand dunes, alluvial fans, and the playa, or normally dry lake beds. The underlying geology contains all the four major rock types, noted in Chapter 2. Parts of the area have saline-alkali accumulations containing moderately to very slowly permeable, deep to very deep silty clay to clay-loam soils. Stratified sandy loam and gravelly sandy alluvium occur in alluvial fans and dry lake terraces bordering the playas. These well-drained to moderately well-drained sandy, reddish brown to brown soils are looser and softer than the silty-clay to clay-loam soils. In limited areas where the best-developed soils of the playas have been irrigated, and especialiy where leaching of excess salts has proved possible, some pasture and field crops have been grown. Limited grazing is locally possible where rainfall is ample to produce forage.

The major biological habitats of the area include saltbush, dunes, marsh, mesquite and playa. The common wildlife associated with these major types includes horned lark, kangaroo rat, jackrabbit, desert tortoise, zebra-tailed lizard and Mojave desert sidewinder in the saltbrush zone; lizards and snakes in the dunes; white-crowned sparrow and red-winged blackbird in the marsh; gopher, shovel-nosed snake and song birds in the mesquite; and

horned lark and feral burro in the playa. The aquatic habitat is also present and represents an important biological component of this environment.

The prehistory cultural resources of the closed drainage basin reflect higher-up probable cave sites, rockshelters and lithic workshops. In lower areas, aboriginal habitation is probably strong with evidence of rock art and petroglyphs. Sacred places and shrines such as those found in the Owens Lake region may also be of paramount importance.

In such an area as this, prehistoric sites probably predominated at the interface between landform types, which is evident along playa shorelines and at junctures of fans and mountains. The lack of vegetation, the landforms and the proximity to springs all had strong effects on any permanent habitation.

Surface indicators of hunting and fishing using projective points are present in the area represented at the Bristol, Cadiz and Danby Desert Dry Lakes. The temporary sites would probably cluster in the valley bottoms, with the chances of some rockshelters or sites along the low desert ranges nearby. Some sites could also be found to a lesser degree in the playas. In addition, these areas are extremely limited as historic sites.

4.5.1 Model Resource V

All the desert playas, dry lakes, fanned terraces, etc. are well known and have long been "mined" for their readily available surface caliche encrustations of salts, sulphates, clay beds, and sometimes peat layers. Chemical recovery on a far larger scale and at greater depths has gone on at Searles Lake near Trona and West End and at Amboy near Bristol Lake.

4.5.1 Model Resource V (continued)

The selection group at the October 1979 Riverside meeting felt that these playas might have deeper level possibilities for containing extremely low concentrations of uranium. This possibility lead to the selection of a mining target centered on uranium at a -3,000 foot depth in a deeper playa deposit. Owens Lake and the brines at Trona are examples of this possibility.

4.5.2 Model Mining Operation V

The exploration phase of this project would be moderately expensive to conduct. It could take five years of research, costing from $1 million to $2 million per year. Several geologists and field helpers would be required to coordinate the aerial and ground surveys and drilling tests. Some of the tools used would include electrical geophysical measurements, fugitive radon measurements and testing for the presence of trace concentrations of molybdenum and uranium in the groundwater. Extensive drilling of many prospects would be required to find one ore body. Such drilling typically requires temporary road construction, especially when many holes are required to test for an indication of continuous ore.

The mine would be designed to last from five to ten years, employing a solution mining technique. The approach would involve pumping large amounts of water into and out of porous bed rocks, in order to leach out trace concentrations of uranium. A source of supplemental water could be required, with several adjacent wells and several miles of pipeline. The operation would look like a moderate-sized oil field. It would also contain facilities for concentrating the uranium into yellow cake, plus several trailers for operational buildings. It would be connected to regional highways by 40 miles of a two-laned service road, constructed of sufficient caliber to allow 5-ton trucks to remove the yellow cake. The power for the facility could either be from a diesel plant or brought in by a 60-mile power line. Several square miles or more could be minimally

4.5.2 Model Mining Operation V (continued)

disturbed by drill probes and well site access roads. The plant would occupy less than five acres. Reclamation of the operation would take place as the system was closed down.

4.5.3 Model Impact Scenario V

The exploration phase for this operation would involve considerable drilling and the construction of temporary access roads. Radioactive testing would also have to be undertaken in order to complete the analysis. Low-level, short-term impacts would be expected for air and water quality, water usage, biological and possibly cultural resources. The development and operation of the mine would involve the disruption of approximately 200 acres, with an additional 100 acres for waste disposal which would exert a major impact on water quality and radiation releases. However, where solution mining is conducted below the water table, a greater quantity of solution is typically pumped from the extraction wells than is reinjected, which helps prevent groundwater contamination. This excess solution, and other plant liquid wastes, can eventually be evaporated in ponds or injected elsewhere.

Typical leach solutions are ammonium bicarbonates, which are weakly alkaline and leave residual ammonia ions to be absorbed into clay minerals in the ground. When mining ceases, the law generally requires restoration of the groundwater to pre-mining conditions. But prior to mining, the groundwater of the project areas typically contains high radium and uranium, and is unfit for consumption. Another major problem in water restoration is the slow bleeding of ammonia ions out of the clays and into the water, which may require years.

4.5.4 Model Resource VI

Tungsten and Molybdenum,[1] to be recovered in brine operations represent the second model resource from the closed drainage basin habitat. Their presence in economic contrations is conjectural at best, but an example basin with good possibilities is the Bristol/Cadiz/Danby Dry Lake chain. They are all located on a Santa Fe Railraod branch line, as shown in Exhibit 4-1. Bristol Lake, or the Saltus station, produces salt and calcium chloride and there is a salt recovery plant on Danby Lake. A new mining operation might be based on log-roll washed salt[2], with chemical production of sodium or potassium carbonates, chlorides if desired, and the suggested by-products of uranium, thorium, tungsten or molybdenum. The project would require study, as well as exploration.

4.5.5 Model Mining Operation VI

The exploration for a tungsten/molybdenum mine could take one geologist several years to develop and define. Costs for the search could exceed $200,000 per year and would include air and ground reconnaisance and drilling activities. Again, during the most preliminary exploration equipment could be flown in by helicopters to minimize environmental damage in special cases.

The operation would again look like a moderate-sized oil field, with wells being used to pump brine to the surface from depths of 200 to 500 feet spread over an area of several square miles. Once at the surface, the brines would be piped into an ion-exchange facility, in order to extract the tungsten and/or molybdenum. Afterwards, the brine would be piped to an evaporation pond, where the salts would be concentrated by natural processes. A 40-mile service road would connect the facilities with a re-

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1 0.001 to 0.0005 ppm have been reported.

2 Salt that is produced and cleaned by a log roll washer.

4.5.5 Model Mining Operation VI (continued)

gional highway and a 60-mile, medium-to-high voltage power line would provide the necessary electricity. With a sufficient deposit, the system could be set up to operate for over 20 years. Reclamation of the operation would be similar to the preceeding examples and the reclaiming would commence as the operation is being closed.

4.5.6 Model Impact Scenario VI

The exploration phase for the tungsten/molybdenum mine would involve minor short-term impacts in the areas of air and water quality, increased water usage, and radiation releases. The development and operation of the system could involve from 1,000-to-1,500 acres for well field and processing plant, with about 100 additional acres for waste disposal. Long-term major impacts on water quality would occur in the groundwater regime due to well activities and the leachate from tailings disposal. Short-term water quality impacts would also occur during the processing phase of the production stage. When reclamation occurs, more water quality impacts would happen during the securing of the ponds.

4.6 IMPACT MATRIX SUMMARY

Table 4-1 provides a six-page summary of potential or maximum impacts to be expected at each of the six mining operations in the three model CDCA environments. Individual keys are included on each page to maximize ease of use.

MODEL IMPACT SCENARIO I: UPLAND LIMESTONE QUARRY

Quarry with crushing and loading facility, mining approximately 5,000 tons per day. Truck anmd shovel operation.

ACTIVITIES		IMPACTS								
		I	II	III	IV	V	VI	VII	VIII	IX
E	1	1-S	1-S	1-S	1-S					
	2	1-S	1-S	1-S			1-S			
	3	1-S	1-S	1-S			1-S			
D	4	1-L	1-S	1-S			1-L			1-S
	5	2-L	1-S	2-S	2-S		3-L	3-S	3-S	3-L
	6	3-L	3-S	2-S	2-S		3-L	3-L	3-L	3-L
	7									
	8	1-S		1-S	1-S					
P	9	3-L	2-S		2-S		3-S	2-S	3-S	3-L
	10	3-L	2-S	2-S			3-L	3-L	3-L	3-L
	11	1-S					1-S		1-S	1-S
	12	1-L					1-L		1-L	1-L
	13		2-S		1-S					
	14	1-L		2-L			1-L		1-L	1-L
	15	3-L	2-S	2-L			3-L		3-L	1-L
	16	1-S							1-S	
R	17	3-L		2-L	2-S		3-L	3-L	3-L	2-L
	18									
	19									

LEGEND

Activities

E. Exploration

1. Drilling
2. Trenching
3. Access Roads

D. Development

4. Development of Tranportation and Utilities
5. Plant Construction
6. Stripping of Overburden
7. Underground Development (or Solution Mine)
8. Employment of Workers

P. Production

9. Drilling and Blasting (open pit)
10. Ore Wast Removal (underground, well, or pit)
11. Stockpiling of Ore
12. Disposal of Mine Waste
13. Benefication, Processing
14. Tailings Disposal
15. Reclamation (beneficial impact during mining)
16. Employment of Workers

R. Reclamation (Beneficial Impacts)

17. Surface Restoration
18. Securing of Ponds
19. Securing of Underground Workings

Impacts

I. Land Surface Disturbance
II. Air Quality
III. Water Quality (surface and groundwater)
IV. Water Use Increase
V. Radiation Release
VI. Flora
VII. Fauna
VII. Land Use, Non-Mining
IX. Archeological, Historical

1 = Low Impact---barely measurable or apparent
2 = Moderate Impact
3 = High Impact---readily apparent

S = Short Term (less than 15 years)
L = Long Term (more than 15 years)

MODEL IMPACT SCENARIO II: UPLAND LEAD/ZINC/SILVER MINE

Underground, room and pillar method, with, flotation mill. Mining approximately 1,000 tons per day. Access by spiral ramp decline.

ACTIVITIES		IMPACTS								
		I	II	III	IV	V	VI	VII	VIII	IX
E	1	1-S	1-S	1-S	1-S					
	2	1-S	1-S	1-S			1-S			
	3	1-S	1-S	1-S			1-S			1-L
D	4	1-L	1-S	2-S			1-L			1-L
	5	3-L	1-S	2-S	2-S		3-L	3-S	3-S	3-L
	6									
	7	2-S	1-S	3-L	3-S	1-S	1-L	1-S	1-L	1-L
	8	1-S		1-S	1-S					
P	9									
	10	1-S	1-S	3-L		1-S	1-L	2-S	1-L	1-L
	11	2-S		2-S	3-S		1-S		1-S	2-S
	12	3-L		3-L			1-L	2-L	2-L	3-L
	13	2-S	3-S	2-S	3-S		1-L		1-L	3-S
	14	3-L	3-L	3-L			3-L	3-L	3-L	3-L
	15	3-L		3-L			3-L	3-L	3-L	3-L
	16	1-S		1-S	1-S					
R	17	3-L			2-S		3-L	3-L	3-L	3-L
	18	3-L	3-L	3-L			1-L	1-L	1-L	1-L
	19	3-L		3-L			1-L	1-L	1-L	1-L

LEGEND

Activities

E. Exploration

1. Drilling
2. Trenching
3. Access Roads

D. Development

4. Development of Tranportation and Utilities
5. Plant Construction
6. Stripping of Overburden
7. Underground Development (or Solution Mine)
8. Employment of Workers

P. Production

9. Drilling and Blasting (open pit)
10. Ore Wast Removal (underground, well, or pit)
11. Stockpiling of Ore
12. Disposal of Mine Waste
13. Benefication, Processing
14. Tailings Disposal
15. Reclamation (beneficial impact during mining)
16. Employment of Workers

R. Reclamation (Beneficial Impacts)

17. Surface Restoration
18. Securing of Ponds
19. Securing of Underground Workings

Impacts

I. Land Surface Disturbance
II. Air Quality
III. Water Quality (surface and groundwater)
IV. Water Use Increase
V. Radiation Release
VI. Flora
VII. Fauna
VII. Land Use, Non-Mining
IX. Archeological, Historical

1 = Low Impact---barely measurable or apparent
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MODEL IMPACT SCENARIO III: LOWLAND BAJADA SPECIALTY CLAY PIT

Pit, small, with preparation and bagging plant. Capacity approximately 100 tons per day. Truck and front-end loader operation.

ACTIVITIES		IMPACTS								
		I	II	III	IV	V	VI	VII	VIII	IX
E	1	1-S	1-S	1-S	1-S					
	2	1-S	1-S	1-S			1-S			
	3	1-S	1-S	1-S			1-S			1-L
D	4	1-L	1-S	1-S			1-L			1-L
	5	2-L	1-S	2-S	2-S		3-L	3-S	3-S	3-L
	6	3-L	2-S	2-S	2-S		3-L	3-L	3-L	3-L
	7									
	8	1-S		1-S	1-S					
P	9	2-L	2-S		2-S		2-S	2-S	2-S	3-L
	10	3-L	2-S	2-S			3-L	3-L	3-L	3-L
	11	2-S					1-S		1-S	1-S
	12	1-L					1-L		1-L	1-L
	13		2-S	1-S						
	14	1-L	2-L				1-L		1-L	1-L
	15	3-L	2-S	2-L			3-L		3-L	1-L
	16	1-S							1-S	
R	17	3-L		2-L	2-S		3-L	3-L	3-L	2-L
	18									
	19									

LEGEND

Activities

E. Exploration

1. Drilling
2. Trenching
3. Access Roads

D. Development

4. Development of Tranportation and Utilities
5. Plant Construction
6. Stripping of Overburden
7. Underground Development (or Solution Mine)
8. Employment of Workers

P. Production

9. Drilling and Blasting (open pit)
10. Ore Wast Removal (underground, well, or pit)
11. Stockpiling of Ore
12. Disposal of Mine Waste
13. Benefication, Processing
14. Tailings Disposal
15. Reclamation (beneficial impact during mining)
16. Employment of Workers

R. Reclamation (Beneficial Impacts)

17. Surface Restoration
18. Securing of Ponds
19. Securing of Underground Workings

Impacts

I. Land Surface Disturbance
II. Air Quality
III. Water Quality (surface and groundwater)
IV. Water Use Increase
V. Radiation Release
VI. Flora
VII. Fauna
VII. Land Use, Non-Mining
IX. Archeological, Historical

1 = Low Impact---barely measurable or apparent
2 = Moderate Impact
3 = High Impact---readily apparent

S = Short Term (less than 15 years)
L = Long Term (more than 15 years)

MODEL IMPACT SCENARIO III: LOWLAND BAJADA PORPHYRY COPPER PIT

Large open pit with flotation plant (underground exploration workings). Truck and shovel operation with complete infrastructure but without townsite.

ACTIVITIES		IMPACTS								
		I	II	III	IV	V	VI	VII	VIII	IX
E	1	1-S	1-S	1-S	1-S					
	2	1-S	1-S	1-S			1-S			
	3	1-S	1-S	1-S			1-S			
D	4	1-L	1-S	2-S			1-L			1-L
	5	3-L	1-S	2-S	2-S		3-L	3-S	3-S	3-L
	6	3-L	3-S	2-S	2-S		3-L	3-L	3-L	3-L
	7	2-S	1-S	3-S	3-S	1-S	1-S	1-S	1-S	1-S
	8	2-S		2-S	2-S					
P	9	3-L	2-S		2-S		3-S	2-S	3-S	3-L
	10	1-S	1-S	3-S		1-S	1-S	2-S	1-S	1-S
	11	2-S		2-S	3-S		1-S		1-S	2-S
	12	3-L		3-L			2-L	2-L	2-L	3-L
	13	2-S	3-S	2-S	3-S		1-L		1-L	3-S
	14	3-L	3-L	3-L		1-S	3-L	3-L	3-L	3-L
	15	3-L	2-L	3-L			3-L	3-L	3-L	3-L
	16	2-S		2-S	2-S					
R	17	3-L	3-L	1-L	2-S		3-L	3-L	3-L	3-L
	18	3-L	3-L	3-L			1-L	1-L	1-L	1-L
	19			3-L						

LEGEND

Activities

E. Exploration

1. Drilling
2. Trenching
3. Access Roads

D. Development

4. Development of Tranportation and Utilities
5. Plant Construction
6. Stripping of Overburden
7. Underground Development (or Solution Mine)
8. Employment of Workers

P. Production

9. Drilling and Blasting (open pit)
10. Ore Wast Removal (underground, well, or pit)
11. Stockpiling of Ore
12. Disposal of Mine Waste
13. Benefication, Processing
14. Tailings Disposal
15. Reclamation (beneficial impact during mining)
16. Employment of Workers

R. Reclamation (Beneficial Impacts)

17. Surface Restoration
18. Securing of Ponds
19. Securing of Underground Workings

Impacts

I. Land Surface Disturbance
II. Air Quality
III. Water Quality (surface and groundwater)
IV. Water Use Increase
V. Radiation Release
VI. Flora
VII. Fauna
VII. Land Use, Non-Mining
IX. Archeological, Historical

1 = Low Impact---barely measurable or apparent
2 = Moderate Impact
3 = High Impact---readily apparent

S = Short Term (less than 15 years)
L = Long Term (more than 15 years)

MODEL IMPACT SCENARIO V: PLAYA URANIUM SOLUTION MINE

3,000 ft depth, in brines or beds below crust. Developed by well field on 500 ft centers with surface recovery plant---hydrometallurgical, producing yellowcake.

ACTIVITIES		IMPACTS								
		I	II	III	IV	V	VI	VII	VIII	IX
E	1	1-S	1-S	1-S	1-S	1-S				
	2									
	3	1-S	1-S	1-S						1-S
D	4	1-L		1-S						1-S
	5	3-L		2-S	2-S					3-L
	6				2-S					
	7			3-L		1-S				
	8	2-S		1-S	1-S					
P	9									
	10				2-S	3-S				
	11					3-S				
	12									
	13	1-L	2-S	3-S	1-S	3-S				
	14	2-L	2-L	3-L		3-L				3-L
	15									
	16	1-S								
R	17	1-L								3-L
	18	3-L		3-L		3-L				3-L
	19			3-L		3-L				

LEGEND

Activities

E. Exploration

1. Drilling
2. Trenching
3. Access Roads

D. Development

4. Development of Tranportation and Utilities
5. Plant Construction
6. Stripping of Overburden
7. Underground Development (or Solution Mine)
8. Employment of Workers

P. Production

9. Drilling and Blasting (open pit)
10. Ore Wast Removal (underground, well, or pit)
11. Stockpiling of Ore
12. Disposal of Mine Waste
13. Benefication, Processing
14. Tailings Disposal
15. Reclamation (beneficial impact during mining)
16. Employment of Workers

R. Reclamation (Beneficial Impacts)

17. Surface Restoration
18. Securing of Ponds
19. Securing of Underground Workings

Impacts

I. Land Surface Disturbance
II. Air Quality
III. Water Quality (surface and groundwater)
IV. Water Use Increase
V. Radiation Release
VI. Flora
VII. Fauna
VII. Land Use, Non-Mining
IX. Archeological, Historical

1 = Low Impact---barely measurable or apparent
2 = Moderate Impact
3 = High Impact---readily apparent

S = Short Term (less than 15 years)
L = Long Term (more than 15 years)

MODEL IMPACT SCENARIO VI: PLAYA LAKE BRINE OPERATION

Producing salt, calcium chloride, Na and K Carbonates (by-product Lithium, tungsten, molybdenum). Shallow (200 ft) well-field on 300 ft centers, with surface recovery plant.

ACTIVITIES		IMPACTS								
		I	II	III	IV	V	VI	VII	VIII	IX
E	1	1-S	1-S	1-S	1-S	1-S				
	2									
	3	1-S	1-S	1-S						1-S
D	4	1-L		1-L						1-L
	5	3-L		2-S	2-S					3-L
	6				2-S					
	7			3-L						
	8	2-S		1-S	1-S					
P	9									
	10				2-S					
	11									
	12									
	13	1-L	2-S	3-S	1-S					
	14	2-L	2-L	3-L		1-L				3-L
	15									
	16	1-S								
R	17	1-L								3-L
	18	3-L		3-L						3-L
	19									

LEGEND

Activities

E. Exploration

1. Drilling
2. Trenching
3. Access Roads

D. Development

4. Development of Tranportation and Utilities
5. Plant Construction
6. Stripping of Overburden
7. Underground Development (or Solution Mine)
8. Employment of Workers

P. Production

9. Drilling and Blasting (open pit)
10. Ore Wast Removal (underground, well, or pit)
11. Stockpiling of Ore
12. Disposal of Mine Waste
13. Benefication, Processing
14. Tailings Disposal
15. Reclamation (beneficial impact during mining)
16. Employment of Workers

R. Reclamation (Beneficial Impacts)

17. Surface Restoration
18. Securing of Ponds
19. Securing of Underground Workings

Impacts

I. Land Surface Disturbance
II. Air Quality
III. Water Quality (surface and groundwater)
IV. Water Use Increase
V. Radiation Release
VI. Flora
VII. Fauna
VII. Land Use, Non-Mining
IX. Archeological, Historical

1 = Low Impact---barely measurable or apparent
2 = Moderate Impact
3 = High Impact---readily apparent

S = Short Term (less than 15 years)
L = Long Term (more than 15 years)

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A

APPENDIX

MINING DISTRICTS AND MINE GROUPS
IN THE
CALIFORNIA DESERT CONSERVATION AREA
(EXCLUDING OIL, GAS, CARBON DIOXIDE, GEOTHERMAL SITES)

Numbered by map location, Map WCP OM-1, 1979

Name - Synonym:	Mining districts, groups of mines, and isolated single mines. In many instances, there are several additional synonyms that are not listed. Some districts have a geographical name referring to a nearby town or topographic feature and also have several names referring to historical boundaries or major claim groups. the Palo Verde or Lugo District, number 228, is also known as Black Beauty, Jackass, and Lost Donkey. Some names occur in several districts; there is a Paymaster District in Imperial County, number 230, and a Paymaster District in Riverside County, number 200.
County:	Township and Range, referring to the approximate center of mineral production. The mines may extend over a larger area. The Cargo Muchacho District, number 247, is listed at T 15 S, R 21 E, but the mines cover some 50 square miles in Townships 14 and 15 South and Ranges 20 and 21 East.
Commodity:	Major commodities, some of which are by-products.

Past Production Etc.:

A = More than $1 billion
B = $100 million to $1 billion
C = $10 million to $100 million
D = $1 million to $10 million
E = Less than $1 million

This is cumulative production in sales or net smelter return at the dollar value when produced. Additional comments refer to the Base Line and Meridian and to additional mineral products.

MINING DISTRICTS AND MINE GROUPS
CDC AREA

No.	Name-Synonym	County	T	R	Commodity	Past Production, etc.
1	Loretto	Inyo	8s	37e	Cu	E Mt. Diablo BL & M
2	Crater & Gulch	Inyo	8 1/2s	39e	Sulfur	E
3	White Eagle	Inyo	13s	37e	Talc	E
4	Gray Eagle, Hilderman	Inyo	13s	37e	Talc	E
5	Saline Valley	Inyo	14s	38e	Salt	E
6	Bonham, White Mtn	Inyo	15s	38e	Talc	E
7	Ubehebe	Inyo	14s	40e	Pb,Ag,Cu,Zn	E
8	Butte	Inyo	15s	41e	Cu,Pb	E
9	Chloride Bluff	Inyo	30n	1e	Au	D San Bern BL & M
10	Cerro Gordo	Inyo	16s	39e	Pb,Ag,Zn,Au,Cu	C Mt Diablo BL & M
11	Keeler	Inyo	16s	38e	Asbestos	E
12	Santa Rosa	Inyo	17s	39e	Pb,Ag,Cu,Zn,Au	E
13	Lee	Inyo	17s	40e	Ag,Zn,Pb	E
14	Big Four	Inyo	17s	42e	Pb,Ag,Zn	E
15	Skiddoo	Inyo	17s	45e	Au	D
16	Calearth	Inyo	18s	38e	Clay	E
17	Talc City	Inyo	18s	40e	Talc	D
18	Zinc Hill	Inyo	18s	41e	Zn,Pb	E
19	Wildrose, Skiddoo	Inyo	18s	45e	Au	E
20	Olancha, Coso Hills	Inyo	19s	37e	Bentonite,U	E
21	Darwin	Inyo	19s	41e	Pb,Ag,Zn,W	C
22	Modoc	Inyo	19s	42e	Pb,Ag,Cu,Zn,Au	D
23	Old Dependable	Inyo	19s	45e	Sb	E
24	Wildrose Canyon	Inyo	19s	45e	Sb	E
25	Badwater	Inyo	24n	1e	Salt	E San Bern BL & M
26	Furnace Creek, Ryan	Inyo	25n	3e	Colemanite	D
27	Death Valley Junction	Inyo	25n	5e	Bentonite	E
28	Greenwater	Inyo	23n	5e	Cu	E
29	Hilltop	Inyo	21s	41e	Sb	E Mt.Diablo BL & M
30	Rocket	Inyo	21s	41e	Sb	E
31	Lemoigne	Inyo	21s	42e	Pb,Ag,Zn	E
32	Panamint	Inyo	21s	45e	Ag	D
33	Millspaugh, Big Four	Inyo	22s	42e	Fe	E
34	Iron Cap, Hoot Owl	Inyo	22s	43e	Fe	E
35	Ballarat, Ratcliff	Inyo	22s	44e	Au,Pb,Zn,Ag	D
36	Galena Canyon	Inyo	23n	1e	Talc, pumice	E San Bern BL & M
37	Shoshone	Inyo	22n	7e	Colemanite	E
38	Coso	Inyo	22s	38e	Hg,Fe,Pumice	E Mt Diablo BL & M
39	Little Lake	Inyo	23s	38e	Sand, Gravel	E
40	Iron Chief & Ferro	Inyo	23s	41e	Fe	E
41	West End	Inyo	23s	43e	Limestone	D
42	Cecil R	Inyo	23s	44e	Au	E
43	Montogmery	Inyo	23s	46e	Talc	E
44	Warm Springs Canyon	Inyo	22n	1e	Talc,fluorite	D San Bern BL & M
45	Ashford,Golden Treasure	Inyo	21n	3e	Au	E
46	Mister	Inyo	21n	4e	Fe	E
47	Pegma	Inyo	21n	4e	Mica	E
48	American	Inyo	20n	5e	Cu,Au,Ag	E
49	Ibex Hills	Inyo	20n	6e	Talc	D
50	China Ranch	Inyo	21n	7e	Gypsum	E

MINING DISTRICTS AND MINE GROUPS
CDC AREA

No.	Name-Synonym	County	T	R	Commodity	Past Production, etc.	
51	Tecopa,Resting Springs	Inyo	21n	7e	Au,Pb,Ag,Zn	D	
52	Argus,Sherman,Kelley	Inyo	24s	42e	Au	E	Mt Diablo BL & M
53	Gold Botton & Ophir	Inyo	24s	43e	Pb,Ag,Zn,Au,Cu	D	
54	Lotus Monte Cristo	Inyo	24s	45e	Au	E	
55	Nine Mile Canyon	Inyo	24s	37e	Feldspar	E	
56	Searles Lake	San B	25s	43e	Borax, Potash, Li	B	Sodium Carbonate, Salt
57	New York Canyon	San B	25s	44e	Au	E	
58	Owlshead Mtns	San B	25s	47e	Magnesite	E	
59	Black Magic, Owl Hole	San B	18n	3e	Fe,Mn.	E	San Bern BL & M
60	Pongo	San B	19n	4e	Talc	E	
61	Saratoga Hills	San B	19n	6e	Talc	D	
62	Western, Acme	San B	19n	8e	Talc	D	
63	Booth	San B	19n	8 1/2s	Talc	E	
64	Beck Canyon	San B	19n	9e	Talc	E	
65	Beck	San B	19n	10e	Fe	E	
66	Excelsior	San B	19n	11e	Talc	E	
67	Indian Wells Canyon	Kern	26s	37e	W,Au	E	Mt Diablo BL & M
68	Hi Peak	Kern	26s	38e	W	E	
69	Inyokern	Kern	26s	39e	Sand, gravel	D	
70	Ridgecrest	Kern	27s	40e	Sand, gravel	D	
71	El Paso Mtns,Black Mtn	Kern	28s	38e	Au,opal,clay	E	also pumice
72	Code Siding, Rademacher	Kern	28s	39e	Wollastonite	E	
73	Goler Gulch	Kern	28s	39e	Au	E	
74	Rademacher	Kern	28s	40e	Au, Wollastonite	E	
75	New Deal, Owl Hole	San B	18n	3e	Mn	E	San Bern Bl & M
76	Avawatz	San B	18n	5e	Celestite	E	
77	Rainbow & Caliente	San B	18n	6e	Talc	E	
78	Sheep Creek	San B	17n	6e	Talc	E	
79	Annex, Silver Hills	San B	17n	8e	Ag	E	
80	Red Canyon	San B	17n	10e	Gypsum	E	
81	Emperor	San B	17n	12e	Cu,Pb,Ag,Au	E	
82	Beatrice	San B	17n	13e	Ag	D	
83	Desert Antimony, Wade	San B	16n	14e	Sb	E	
84	Mountain Pass	San B	16n	14e	Rare earths,barite	C	
85	Nipton	San B	16n	16e	Fluorite	E	
86	Iron Mtns, Silver Lake	San B	15n	6e	Fe	E	
87	Silver Lake	San B	16n	9e	Talc	E	
88	Yucca, Silver Lake	San B	15n	11e	Talc, Au,Sn	D	also Turquoise
89	Clark Mountain	San B	16n	12e	Ag,Cu,Zn,Pb,W	D	also Fluorite
90	Ivanpah	San B	15n	13e	Au,Ag,Cu	E	
91	Cima Cinders	San B	14n	12e	Cinders	E	
92	Mescal	San B	15n	14e	Au,W,Ag,Au,Pb,Sn	E	
93	Vanderbilt, New York	San B	14n	16e	Au,Ag	E	
94	Castle Mountains,Hart	San B	14n	18e	Au,Clay, Perlite	E	
95	St. John	Kern	28s	35e	Au	E	
96	Red Rock Canyon	Kern	29s	37e	Au	E	
97	Cudahy	Kern	29s	38e	Pumice	E	
98	Koehn Lake	Kern	30s	38e	Gypsum,Salt,Borax	E	
99	Jawbone Canyon	Kern	30s	36e	Au,W,clay,stone	E	
100	Cowboy No 1, Amalia	Kern	31s	36e	Sb	E	

MINING DISTRICTS AND MINE GROUPS
CDC AREA

No.	Name-Synonym	County	T	R	Commodity	Past Production, etc.
101	Randsburg, Rand	Kern	29s	40e	Au,Ag,W,Mn,Talc	C
102	Johannesburg	San B	29s	41e	Bentonite	E
103	Atolia	San B	30s	41e	W,Sb	C
104	Old Dad	San B	13n	10e	Au	E
105	Death Valley,Cima	San B	13n	14e	Ag	E
106	Bull Dog, Antimony	Kern	12n	12w	Sb	E
107	Pine Tree, Victoria	Kern	11n	15w	Au,W	E
108	Creal	Kern	11n	14w	Lmestne,quartzite	C
109	Nob Hill	Kern	32s	38e	U	E
110	White Butte S	San B	32s	43e	Feldspar	E
111	White Butte N	San B	31s	44e	Feldspar	
112	Williams Brothers	San B	32s	46e	Pumice	E Mt Diable BL & M
113	Starbright	San B	12n	1e	W	E San Bern BL & M
114	Alvord	San B	12n	3e	Au	E
115	Afton	San B	11n	6e	Fe,flour, mag	E also limestone
116	Specular	San B	11n	12e	Fe	E
117	Vontrigger	San B	21n	17e	Cu,Au,Ag	E
118	Leiser Ray	San B	11n	18e	V,Cu,Ag,Pb	E
119	Antelope Valley	L.A.	8n	16w	Au,Ag	E
120	Tropico	Kern	9n	13w	Au	D
121	Sweetzer, Rosamond	Kern	9n	12w	Feldspar,Au,Ag	C
122	Mahary,Houghtanworth	Kern	9n	13w	Sb	E
123	Bissell	Kern	10n	11w	Magnesite	E
124	Kramer, Boron	Kern	10n	7w	Borax,borates	A
125	Four Corners	San B	10n	6w	Colemanite,borate	E
126	Kramer Hills	San B	9n	6w	Magnesite	E
127	Sloan	San B	10n	3w	Feldspar	E
128	Hinkley	San B	9n	4w	Dolomite	E
129	Waterman	San B	10n	2w	Ag	D
130	Mud Hills, Solomon	San B	11n	1w	Strontianite	E
131	Calico	San B	10n	1e	Ag,coleman, borate	C also barite
132	Providence, Vulcan	San B	10n	13e	Fe	D
133	Bell Gilroy	San B	10n	14e	Pb,Ag	E
134	Run Over Consol	San B	10n	17e	Cu,Ag	E
135	Piute	San B	9n	18e	Au,Zn,Pb,Ag	E
136	White Moon, Needles	San B	8n	21e	Magnesite	E
137	Big Butte, Copper Gulch	San B	9n	22e	Au,Ag,Cu	E
138	Shadow Mtn, Just	San B	8n	7w	W	E
139	California Dolomite	San B	7n	6w	Dolomite	E
140	Vitrilite Mohave Marl	San B	8n	4w	Marl	E
141	Hodge	San B	8n	3w	Mica,Quartzite	E
142	Marter-White	San B	7n	4w	Rock (Quartzite)	D
143	Altuda, Globerson	San B	8n	3w	Fe	E
144	Victorite	San B	7n	3w	Pyrophyllite	E
145	Keystone	San B	7n	2w	Au,Ag	E
146	Sidewinder Mtn	San B	6n	2w	Au,Ag,magnesite	E also marble
147	Barstow	San B	9n	1w	Sand,gravel,barite	D also stone
148	Ord Mountain	San B	7n	1e	Au,Ag,Cu	E
149	Copper Strand	San B	6n	3e	Cu	E
150	Ebony	San B	6n	4e	Fe	E

MINING DISTRICTS AND MINE GROUPS
CDC AREA

No.	Name-Synonym	County	T	R	Commodity	Past Production, etc.
151	Hector	San B	8n	5e	Bentonite	E
152	Logan	San B	9n	6e	Mn	E
153	Mt. Pisgah	San B	8n	6e	Cinder	E
154	Big Reef,Black Butte	San B	8n	6e	Mn	E
155	Cady Mtns, Ludlow	San B	8n	7e	Celestite	E
156	Lee Yim	San B	8n	7e	Mn	E
157	Lavic	San B	8n	8e	Barite	E
158	Glassy Rock	San B	8n	10e	Perlite	E
159	Katz	L.A.	6n	13w	Soaptsone, talc	E
160	Palmdale	L.A.	6n	12w	Gypsum	E
161	Little Rock	L.A.	5n	11w	Stone	E
162	Pearl Blossom	L.A.	5n	10w	Limestone	E
163	Largo Vista, Americal	L.A.	4n	9w	Limestone	E
164	Victorville, Oro Grande	San B	5n	4w	Au,Ag,sand,gravel	C also stone
165	Cushenbury	San B	3n	1w	Limestone	C
166	Lava Bed,Bessemer	San B	5n	4e	Fe	E
167	Morris Lode, Van Buren	San B	5n	5e	Fe	E
168	Bagdad Chase, Stedman	San B	7n	8e	Au,Cu,Ag,Pb,Bi	D
169	Dish Hill	San B	6n	10e	Cinder	E
170	Hercules	San B	7n	11e	Cu	E
171	Bristol Lake	San B	5n	12e	Cal,chlride,salt	C also gypsum, barite
172	Iron Hat	San B	6n	13e	Fe	E
173	Cadiz	San B	6n	14e	Marble	E
174	Ship Mtns, Paul	San B	5n	15e	Fe	E
175	Bimetallic,Dsrt Mercury	San B	6n	17e	Hg	E
176	Old Woman Mtns	San B	5n	17e	W	E
177	Stewart	San B	3n	24e	Mn	E
178	Whipple Mountains	San B	3n	23e	Au,Cu	E
179	American Eagle	San B	3n	24e	Cu	E
180	Manganese King	San B	3n	25e	Mn	E
181	Copper Basin	San B	3n	26e	Cu	E
182	Lava Beds	San B	1n	5e	Ag	E
183	Twenty Nine Palms	San B	1n	9e	Sand,gravel	E
184	Copper World	San B	2n	11e	Fe	E
185	Dale Lake	San B	1n	12e	Salt,sodiumsulfate	E
186	Chubbuck	San B	3n	16e	Limestone	D
187	Danby Lake	San B	2n	17e	Salt,sodiumsulfate	E
188	Vidal	San B	1n	23e	Bentonite	E
189	Black Metal	San B	1n	24e	Cu,Ag	E
190	Earp	San B	1n	25e	Sand,gravel	E
191	Whitewater	Riv	3s	3e	Sand,gravel	E
192	Desert Hot Springs	Riv	2s	4e	Sand,gravel	E
193	Garnet	Riv	3s	4e	Sand,gravel	E
194	Palm Springs	Riv	4s	4e	Sand,gravel,lmstne	D
195	Thousand Palms	Riv	4s	6e	Sand,gravel	E
196	Sulphide Bismuth, Lang	Riv	2s	7e	Bi	E
197	Pinon	Riv	3s	8e	Au	E
198	Gold Park	Riv	2s	9e	Au	E
199	Music Valley	Riv	2s	10e	Monazite	E
200	Paymaster	Riv	3s	10e	Au	E

MINING DISTRICTS AND MINE GROUPS
CDC AREA

No.	Name-Synonym	County	T	R	Commodity	Past Production, etc.
201	Winfield No.2	Riv	4s	10e	Cu,Pb,Au,Ag	E
202	Oro Mega	Riv	3s	12e	Pb,Ag,Au	E
203	Dale,Virginia Dale	San B	1s	12e	Fe,Au	D
204	Iron Age	San B	1s	13e	Fe	D
205	Black Eagle	Riv	3s	13e	Cu,Au,Pb,Ag	E
206	Eagle Mountain	Riv	4s	14e	Fe,Au	B
207	Desert Eagle	Riv	3s	15e	Fe	E
208	Fluorspar	Riv	3s	18e	Fluorite	E
209	Red Bluff	Riv	3s	20e	Fluorite	E
210	Manganese Canyon	Riv	4s	19e	Mn	E
211	Little Maria Mtns	Riv	3s	20e	Pb,Ag,Cu,Zn,Mn	D also Fluorite, Gyp
212	Iron King-Iron Queen	Riv	5s	17e	Fe	E
213	Palen Copper	Riv	5s	18e	Cu	E
214	McCoy Mtns	Riv	5s	20e	U,Pb,Cu,Au,Ag	E
215	Big Maria Mtns	Riv	4s	22e	Au,Sand,Gravel	D also stone
216	Indio	Riv	5s	8e	Sand, gravel	D
217	Charleboix,Percival	Riv	6s	5e	Asbestos	E
218	Salton Sea	Riv	8s	10e	Salt	E
219	Orocopia	Riv	6s	11e	Fluorite	E
220	Matilda	Riv	7s	15e	W	E
221	Golden Key	Riv	6s	16e	Au,Ag	E
222	Blythe	Riv	6s	22e	Limestone,gravel	E
223	Hilton	S.Diego	10s	8e	Calcite	E
224	Durmid Hills	Imperial	9s	12e	Sodium sulfate	E
225	Salton Sea	Imp	10s	12e	Salt	E
226	Marcella,Imperial Butte	Imp	9s	15e	Pb,Zn,Ag,Au	E
227	White Swan	Imp	9s	19e	Barite	E
228	Palo Verde, Lugo	Imp	9s	20e	Mn,Barite	D
229	Niland, Mullet Island	Imp	11s	13e	CalciumChloride	E also Salt
230	Paymaster, Pioneer	Imp	11s	21e	Mn,Au,Ag,Pb,Cu	D
231	Obsidian Butte	Imp	11s	13e	Pumice	D
232	Roberts-Peeler,Ocotillo	S.Diego	12s	8e	Celestite	E
233	Imperial Gyps,Fish Creek	Imp	13s	9e	Gypsum	C
234	Westmoreland, McElvanty	Imp	13s	12e	Sand,gravel	D
235	Mary Lode	Imp	12s	18e	Au	E
236	Land, Big Chief	Imp	13s	19e	Au	E
237	McKnight	Imp	12s	19e	Clay	E
238	Indian Pass	Imp	13s	21e	Gemstones	E
239	White Gold, Gold Dream	Imp	13s	23e	Au,Ag,Pb	E
240	Deer Park	S.Diego	14s	5e	Au	E
241	Dos Cabezas	S.Diego	16s	8e	Limestone	E
242	Coyote Mtns	Imp	15s	9e	Clay,marble,sand	E
243	P-K, Elliott	Imp	13s	12e	W	E
244	El Centro	Imp	15s	14e	Sand,gravel,clay	D
245	Brawley	Imp	14s	16e	Sand,gravel,clay	D
246	Holtville	Imp	15s	16e	Sand,gravel	D
247	Cargo Muchacho	Imp	15s	21e	Au,Ag,Cu,W,Mica	D
248	Picacho	Imp	14s	22e	Au	D
249	Potholes	Imp	15s	23e	Au	D
250	Picacho Creek,Valley	Imp	16s	22e	Sand,gravel	E
251	Three "C"	Imp	15s	23e	Au	E

Bureau of Land Management
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